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**REPORT ON THE CHARACTERIZATION OF
PARTICULATE AND GASEOUS EMISSIONS FROM THE
GAS-FIRED COAL DRYER AT WESTAR MINING LTD.
SPARWOOD, BRITISH COLUMBIA**

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TABLE OF CONTENTS

	Page
LIST OF FIGURES	ii
LIST OF TABLES	iii
LIST OF APPENDICES	iv
ACKNOWLEDGEMENTS	v
1 INTRODUCTION	1
2 PROCESS DESCRIPTION	2
3 TEST SITE	6
4 TEST SCHEDULE	8
5 SAMPLING METHODS	9
5.1 Particulates/Heavy Metals/HCl	9
5.2 Dioxins, Furans, PAH's and PCB's	9
5.3 Continuous Monitoring	14
5.4 Process Streams	16
6 ANALYTICAL METHODOLOGIES	18
7 RESULTS	19
7.1 Particulates/HCl	19
7.2 SO ₂ , NO _x , CO, THC and O ₂	19
7.3 Heavy Metals	22
7.4 Organics	24
8 DISCUSSION	29

LIST OF FIGURES

Figure		Page
1	FLOWSHEET - GAS-FIRED DRYER PLANT	3
2	SCHEMATIC OF SAMPLING SITE	7
3	PARTICULATES/HEAVY METALS/HCl TRAIN AND RECOVERY PROCEDURES	10
4	DIOXINS/ URANS AND PAH/PCB SAMPLING TRAIN	12
5	SAMPLE PARTITIONING AND RECOVERY PROCEDURES - ORGANIC TRAIN	13
6	CONTINUOUS SOURCE MONITORING SYSTEM	15

LIST OF TABLES

Table		Page
1	SUMMARY OF PROCESS DATA	4
2	ANALYTICAL RESULTS FOR COMPOSITE COAL SAMPLE	5
3	SUMMARY OF PARTICULATE RESULTS	20
4	SUMMARY OF CONTINUOUS SO ₂ , NO _x , CO, THC AND O ₂ RESULTS	21
5	SUMMARY OF HEAVY METAL RESULTS	23
6	SUMMARY OF DIOXIN AND FURAN RESULTS	25
7	SUMMARY OF TRAIN AND STACK DATA - PAH RUNS	26
8	SUMMARY OF PAH RESULTS	27

LIST OF APPENDICES

APPENDIX

- I DETAILED PLANT DESCRIPTION**
- II ANALYTICAL METHODS AND REPORTS**
- III STACK TRAVERSE DATA**

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On behalf of Environment Canada, the authors wish to express their appreciation to the staff of Westar Mining Ltd., Sparwood Plant, for their cooperation and assistance during the test program and; to the Analytical Services Division (RRETIC, Ottawa) for performing the inorganic and organic analyses.

1 INTRODUCTION

In August 1984, the Technical Services Branch of EPS in cooperation with the Industrial Programs Branch and the Pacific Region in Vancouver carried out a series of air emission source tests on the wet scrubber stack of a gas-fired coal dryer located at the coal preparation plant operated by Westar Mining in Sparwood, B.C.

These tests were carried out to characterize the particulate and gaseous emissions from an environmentally controlled, gas-fired thermal dryer and to evaluate sampling methodologies for the identification of trace organic emissions. Stack samples were collected to determine the emissions of particulates, selected heavy metals, gaseous HCl and trace organic compounds. Stack gas concentrations were also analyzed on a continuous basis for sulfur dioxide, nitrogen oxides, carbon monoxide, total hydrocarbons and oxygen.

2 PROCESS DESCRIPTION

After mechanical dewatering, the 6mm x 0 cleaned coal is dried in a twin FMC Link Belt fluid bed dryer with a total evaporative capacity of 90 tonnes of water per hour. The air heater is fired with natural gas.

The hot gases exit the dryer body and pass through two dust cyclones which collect coarse coal particles. Finer material exits the cyclones and passes through an exhaust fan to a wet impingement scrubber operating at approximately 1 kPa and using 13 000 litres per minute of water in the intermediate spray nozzles and 14 000 litres per minute of water in the high pressure spray nozzles. The scrubber effluent is pumped to the preparation plant clean coal thickener and the overflow from the thickener is recycled to the scrubber. The saturated, scrubbed gases are vented through two mist eliminator stacks to the atmosphere. Figure 1 depicts the gas-fired dryer layout and process.

The cleaned coal feed rate to the dryer is varied according to the desired moisture level required in the product coal reporting to the final product storage silos. This is accomplished by by-passing coarse coal and some finer washed coal to the storage silos. The wash plant has a design capacity of 1600 tonnes per hour of metallurgical coal.

Process data gathered during the survey is attached in Table 1. Each sample run was observed from the dryer plant control room and any unexpected delays or shutdowns in the process necessitated a stoppage in the sampling schedule. All stack monitoring was performed during normal operating conditions in the plant.

Clean coal samples were obtained during each sample run. A composite sample was made up from all the coal samples obtained and the analytical results are given in Table 2.

A more complete description of the wash plant and other associated plant operating variables are contained in Appendix I.

Figure 1 - Flowsheet - Gas-Fired Dryer Plant

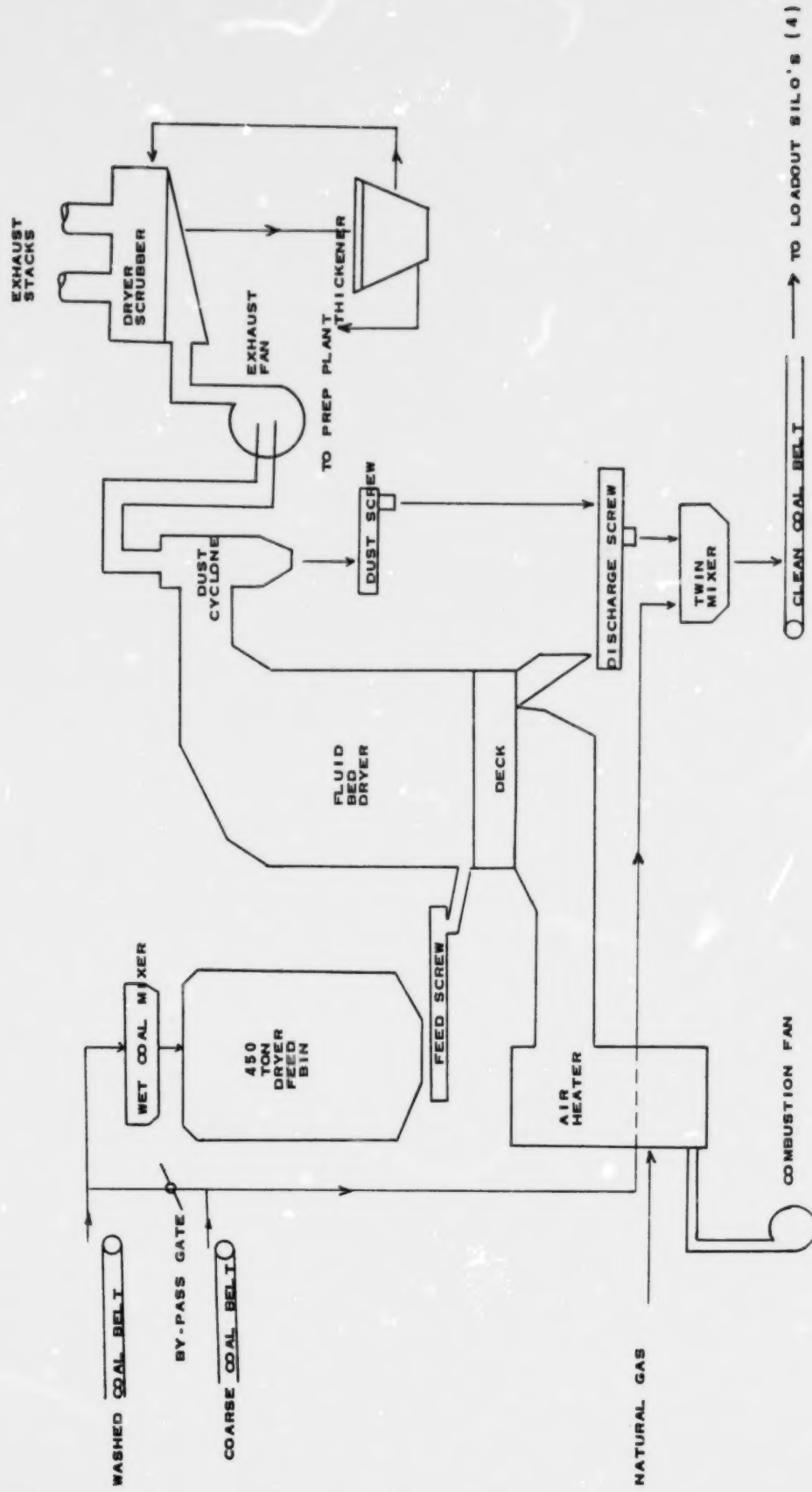


TABLE I SUMMARY OF PROCESS DATA

ELKVIEW COAL PREPARATION PLANT - DRYER REPORT					
<u>General Data</u>					
Run Number	1	2	3	4	5
Date (1984)	Sept. 8	Sept. 9	Sept. 10	Sept. 11	Sept. 12
Time	10:00 - 13:30	12:30 - 17:00	17:30 - 18:30	14:00 - 17:30	12:00 - 16:00
Met Coal Processed					
Tonnes	2460	3785	805	1980	3800
Tonnes per Hour	700	850	800	550	950
<u>Scrubber Characteristics</u>					
Vacuum Below Louvers	20	20	20	20	19
Vacuum Above Louvers	12	19	12	12	14
Vacuum at Bed	6	6.5	7	4.5	5
Scrubber Pressure	4	4	4	4	4
<u>Dryer Characteristics</u>					
Furnace Temperature	850	1070	700	630	725
Inlet Temperature	685	860	500	475	550
Exhaust Temperature	140	145	145	140	145

TABLE 2 ANALYTICAL RESULTS FOR COMPOSITE COAL SAMPLE

WESTAR MINING - ELKVIEW	
Element or Parameter	%
Al	1.45
Ba	0.02
Ca	0.16
Fe	0.17
K	0.04
Mg	0.05
Na	0.01
P	0.04
Si	2.56
Sr	0.01
Ti	0.11
LOF (I)	0.08
C	79.67
ash	10.19
moisture	0.42
volatile	21.18
fixed carbon	68.21
H	4.28
S	0.30
N	1.30
O (by difference)	3.84
heat value	7728 (cal/g) 32.36 (MJ/kg)
S (pyritic)	0.06
S (organic)	0.24

Note: (I) LOF loss on fusion

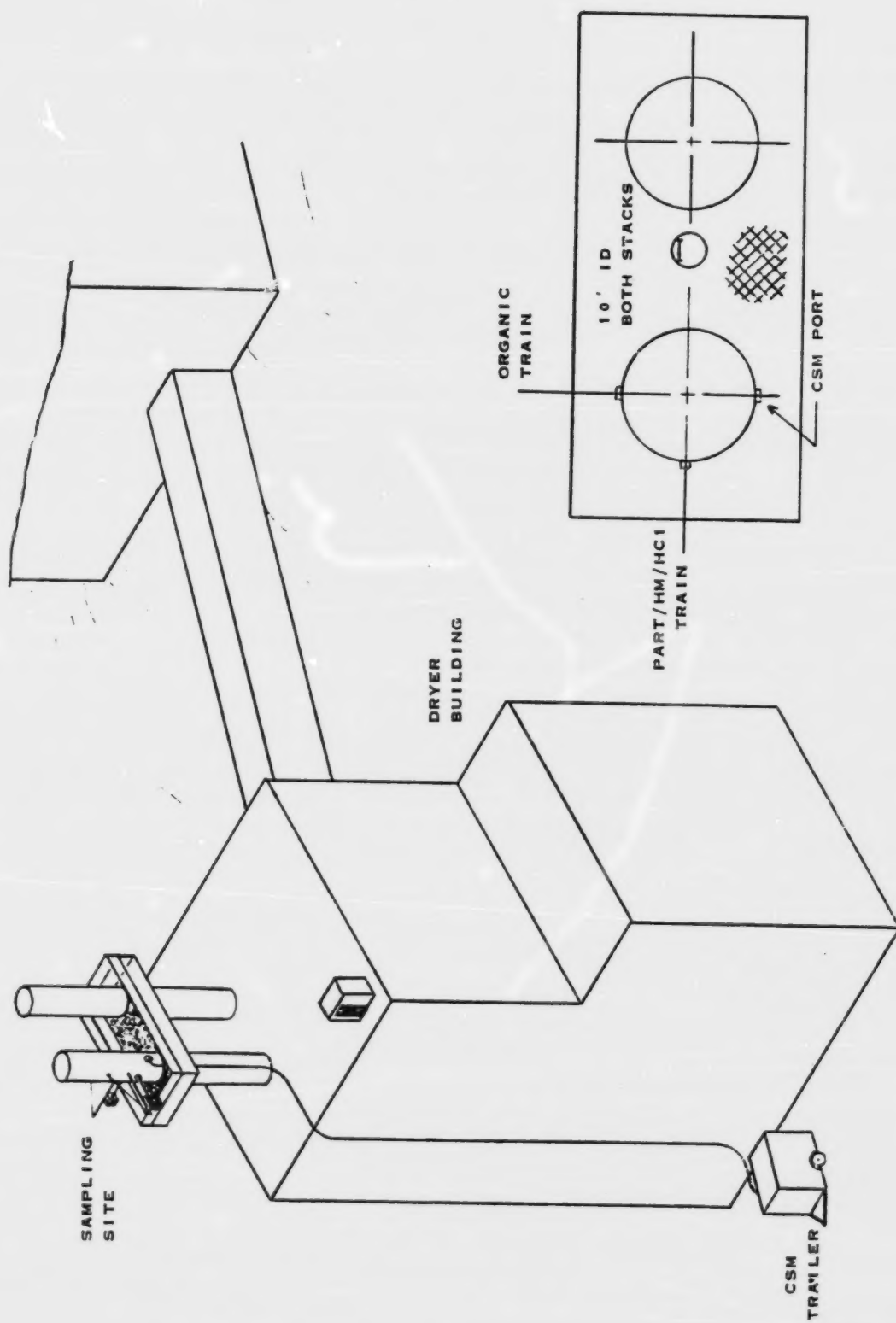
3 TEST SITE

Stack sampling was conducted on the west stack of the drying plant. The stack gas was extracted from the north and west ports. Sample gas for the continuous monitoring analyzers was drawn from the south port (Figure 2).

The measured stack diameter at the sampling level was 120 inches. Since the ports were located approximately six stack diameters downstream of the flow disturbance, the number of sampling points were increased from 16 to 24 points.

The high winds encountered at this site required a change in the sampling strategy. Since the organic train was very susceptible to wind damage it was decided not to switch ports between traverses. As a result, the organic train was set up on the leeward side of the stack (north port) and the particulates/heavy metals train was installed on the west port.

Figure 2 - Schematic of Sampling Site



4 TEST SCHEDULE

A total of ten valid tests were completed by the Pollution Measurement Division during the period 8 September to 12 September 1984. The sampling schedule is shown below.

SAMPLING SCHEDULE

Date (1984)	Run Number	Sampling Duration (min)
September 8	Dioxin/Furan - 1	192
	Part - 1	192
September 9	Dioxin/Furan - 2	240
	Part - 2	240
September 10	PAH's/PCB'S -1	82.5
	Part - 3	83.1
September 11	PAH's/PCB's - 2	192
	Part - 4	192
September 12	Dioxin/Furan - 3	240
	Part - 5	240

5 SAMPLING METHODS

5.1 Particulates/Heavy Metals/HCl

The standard reference method for particulates was used for the determination of particulates, heavy metals and gaseous chlorides. Particulate loadings and heavy metal emissions were determined from the front-half washes and loaded glass fibre filters. Gaseous HCl was determined from the distilled water in the first two impingers.

A sample of stack gas was extracted from the stack using a 10 1/2 foot glass-lined probe. Sampling was conducted isokinetically at each point along two traverses from a single port. Each traverse consisted of 24 points (run total 48 points, 24 in and 24 out). Sampling duration was four to five minutes per point. Usually the length of the run was determined by pending process shutdowns. Leak checks were performed at the beginning and at the end of each run. The pitot lines on both the particulate and organic trains were blown out at each point due to the build-up of water in the pitot tubes. Condensation in the liners was avoided by wrapping the probes with insulation.

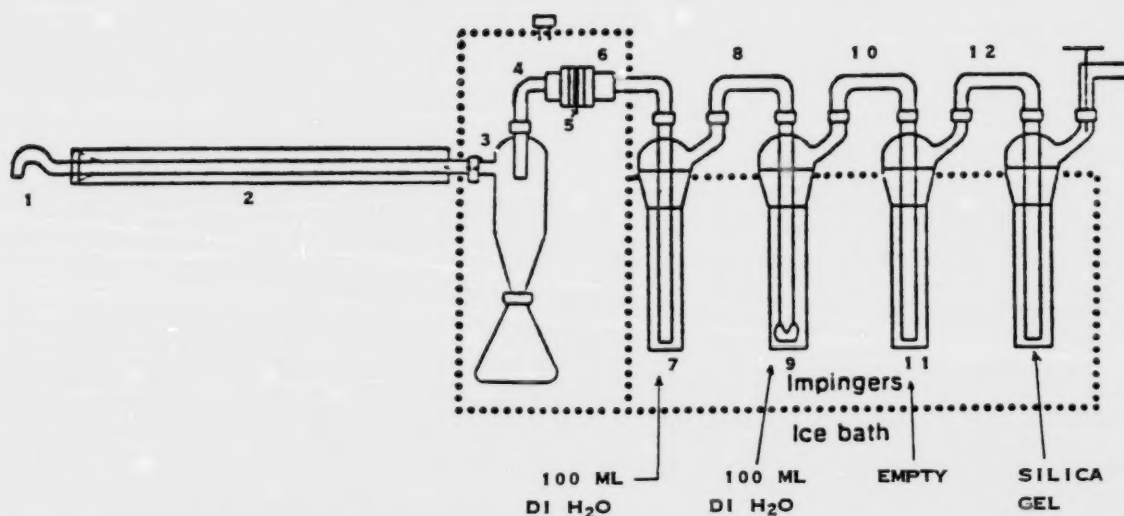
Upon completion of sampling, the probe and filter were disconnected from the sampling train and all openings sealed on-site to avoid sample loss or contamination. Particulates were quantitatively recovered from the nozzle, probe, cyclone and front-half of the filter holder by brushing with acetone. All these washings were stored in one container. The filter was carefully removed from the filter support and carefully placed into a petri dish which was immediately sealed. The distilled water impinger solutions were transferred to a clean bottle. All samples were labelled and shipped to Ottawa. The particulate sampling train and the sample recovery and partitioning procedures are shown in Figure 3.

Following gravimetric determination, the front-half wash residues and filters were passed to the Analytical Services Division (ASD) for heavy metals analysis. Impinger solutions were analyzed for chloride ion.

5.2 Dioxins, Furans, PAH's and PCB's

The Modified Method 5 (MM5) train was used for the collection of organic compounds. This train is widely accepted for sampling organics with boiling points above 100°C. In this train, particulate matter was collected on a glass fibre filter and a cyclone. Gaseous organics were trapped in a single sorbent tube containing Amberlite

Figure 3 - Particulates/Heavy Metals/HCl Train & Recovery Procedures



	CONTAINER OR SAMPLE	COMPONENTS	RECOVERY PROCEDURE
FRONT HALF	1	1, 2, 3, 4	WASH AND BRUSH WITH ACETONE RINSE WITH ACETONE
	2	5	REMOVE FROM FILTER HOLDER AND REPLACE IN ORIGINAL PETRI DISH AND SEAL
BACK HALF	3	7, 9 6, 7, 8, 9, 10, 11, 12	DUMP CONTENTS INTO CONTAINER RINSE WITH DH ₂ O

XAD-2, a styrene resin. As the temperature of the resin must be maintained below 20°C for optimal efficiency, the hot gases leaving the heated filter enclosure were cooled by passing them through a water-cooled condenser. Condensate formed in the cooling coil percolated through the resin bed and was collected in a condensate bottle. An impinger containing ethylene glycol was inserted downstream of the XAD-2 to check for breakthrough of organics through the resin tube. For the PAH/PCB runs, a second glycol impinger was added. The resin tubes were covered with aluminum foil during sampling and storage to prevent any possible photodegradation of the trapped organics. A schematic of the organic train is illustrated in Figure 4.

Prior to the test program, all train glassware, amber storage bottles, Teflon lid liners, glass wool and aluminum foil were cleaned following a rigorous cleaning procedure. The XAD-2 resin was pre-cleaned by extracting with distilled water, methanol, methylene chloride and hexane. The resin, glass fibre filters and solvents used for recovery were screened for contamination prior to the survey. All recovery chemicals were of distilled-in-glass grade. All glassware openings were sealed with pre-cleaned glass caps or hexane-rinsed aluminum foil.

At the site, only Teflon wash bottles were used for sample recovery. Glassware joints were sealed by wrapping the ball joints with Teflon tape as vacuum greases are not permitted for organic sampling. Prior to the start of each run, all train glassware was rinsed once with hexane.

Following each test, the sampling train was partially disassembled on-site and all openings were sealed with pre-cleaned caps or rinsed foil. The train was recovered in a makeshift lab. Basically the recovery procedure involved the brushing and rinsing of most of the train glassware with acetone and hexane. Liquid samples were stored in pre-cleaned amber bottles to prevent photodegradation. Bottle lids were lined with pre-cleaned Teflon sheets. Amberlite tubes were capped and re-wrapped in aluminum foil. The samples were partitioned to permit evaluation of the sorbent efficiency and rinsing procedures. Following recovery, all samples were refrigerated and kept on ice until the samples were passed on to the ASD. The sample partitioning and recovery procedures are detailed in Figure 5.

In addition to the train samples, a number of field reagent and blank train samples were submitted as quality control checks. Reagent blanks included HPLC water, acetone, hexane and XAD-2. Filter blanks were also submitted for organics screening. Two blank trains were assembled at the site - one for dioxins/furans and the other for

Figure 4 - Dioxins/Furans & PAH/PCB Sampling Train

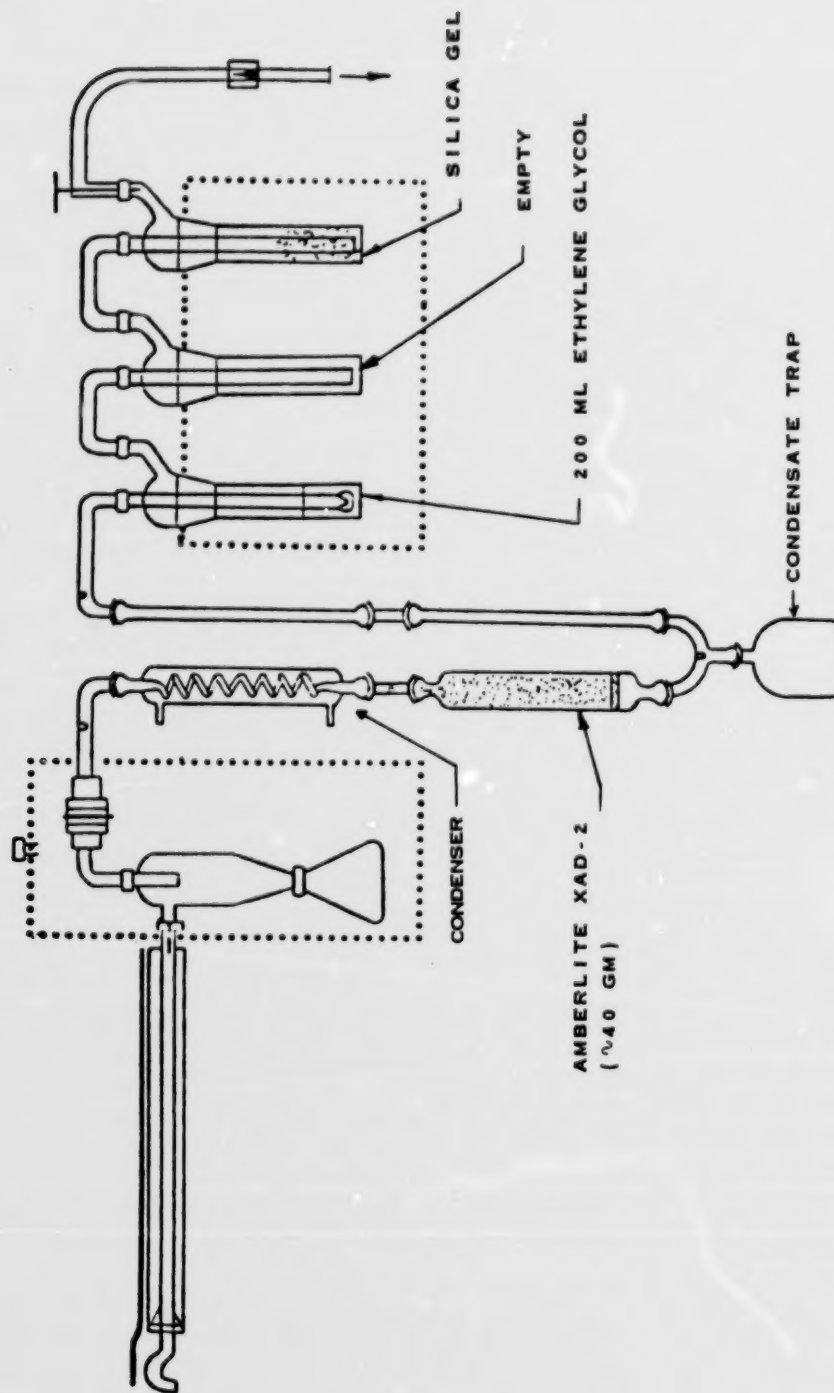
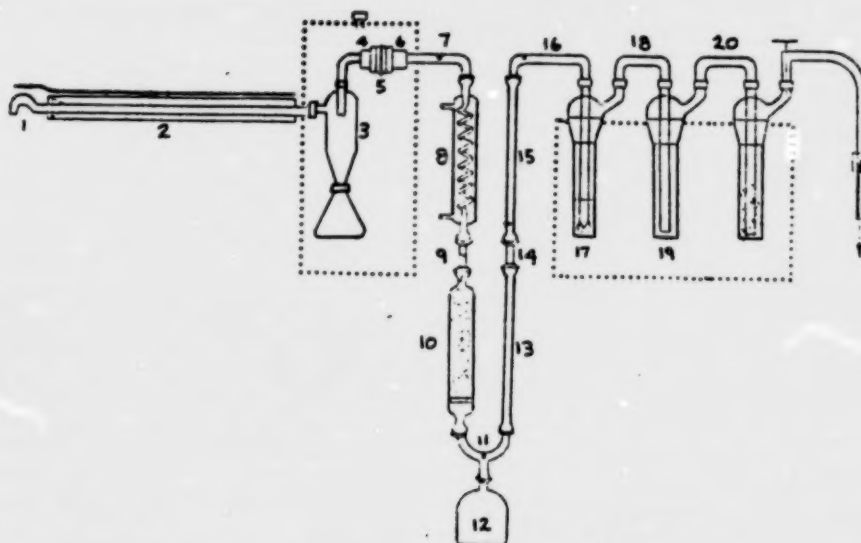


Figure 5 - Sample Partitioning & Recovery Procedures - Organic Train



CONTAINER OR SAMPLE	COMPONENTS	RECOVERY PROCEDURE
1	1, 2, 3, 4	WASH & BRUSH WITH ACETONE (A) AND HEXANE (H)
	5	FOLD CAREFULLY AND IMMERSE IN CONTAINER
2	1, 2, 3, 4	RINSE TWICE WITH A AND H
3	6, 7, 8, 9	SOAK WITH A AND H AT LEAST 5 MINUTES EACH. RINSE TWICE WITH A AND H
4	10	CAP ENDS, KEEP WRAPPED IN AL FOIL
5	12	DUMP CONTENTS OF TRAP INTO CONTAINER
	11, 12	RINSE TWICE WITH A AND H
6	17	DUMP IMPINGER CONTENTS INTO CONTAINER
	17	RINSE WITH ETHYLENE GLYCOL AND DH ₂ O
	13, 14, 15, 16	RINSE WITH ETHYLENE GLYCOL AND DH ₂ O
	18, 19	RINSE WITH DH ₂ O
7	6, 7, 8, 9	RINSE TWICE WITH A AND H
8	11, 12, 13, 14, 15 16, 17, 18, 19, 20	RINSE TWICE WITH A AND H

PAH's/PCB's. The blank trains were treated in the same manner as the sample train except that no stack gases were sampled. However, a volume of ambient air, equal to that drawn during the pre-and post-traverse leak checks was drawn through the blank train. Essentially, the blank train serves as a check for background levels of organics originating from ambient air, handling and contaminated reagents or chemicals.

5.3 Continuous Monitoring

Continuous monitoring was conducted for SO₂, NO_x, CO, THC (lighter fractions) and O₂. A list of the analyzers that were used during the test program are described in the following table.

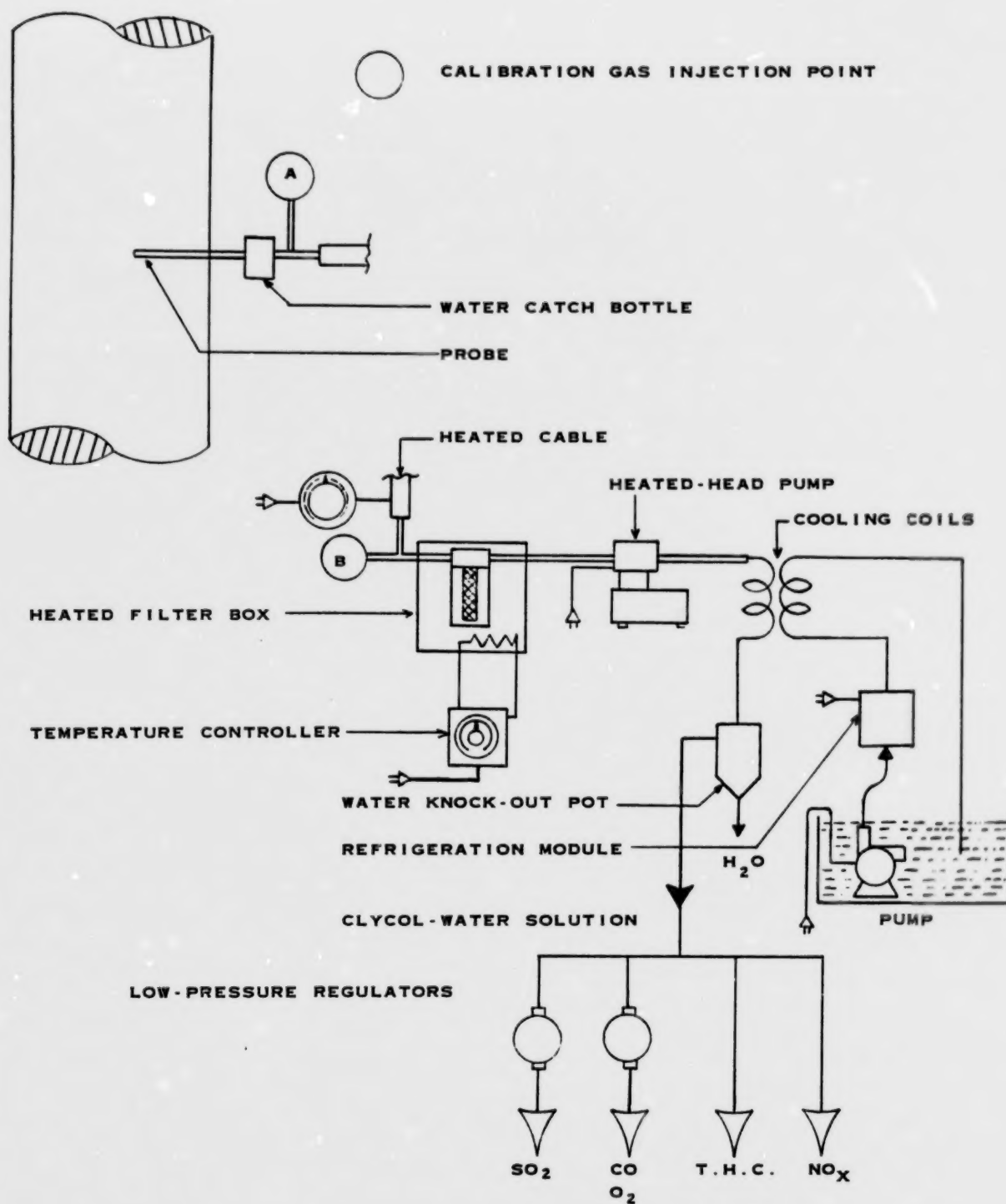
DESCRIPTION OF ANALYZERS

Compound	Analyzer	Range	Detection Principle
SO ₂	WRI 721A	0-2000 ppm	NDUV
NO _x	Teco 10AR	0-250 ppm	Chemiluminescence
CO	Bendix 8501	0-1000 ppm	NDIR
THC	Beckman 400	0-1000 ppm	Cold FID
O ₂	Teledyne 320	0-25%	Electrochemical

A diagram of the conditioning system employed during the study is presented in Figure 6. The purpose of the conditioning system was to remove all forms of water and particulate matter from the flue gas prior to its introduction to the analyzers. The presence of water droplets from the drying plant stacks required some modification to the standard sample conditioning technique. The in-stack filter normally used to filter particulates was removed to prevent blinding and a water catch bottle was inserted between the probe exit and heated sample line. Some particulates were also removed in the first water trap. The sample gas was then drawn through a heated sample line into a heated filter box to remove the rest of the particulate matter. Finally, the sample gas was cooled to about 7°C in a countercurrent heat exchanger to remove more water.

Calibration of the various analyzers was carried out by injection of commercially available gas mixtures. The oxygen monitor was calibrated with ambient air. A list of the calibration gases used during the survey is shown in the following table.

Figure 6 - Continuous Source Monitoring System



LIST OF CALIBRATION GASES

Component	Concentration (ppm)
SO ₂ in N ₂	1900
NO in N ₂	500
CO in air	205
HC in air	100
O ₂	ambient air

Calibration gases were injected at two points in the system. Injection at Point "B" (Figure 6) offered a quick calibration of the conditioner and analyzers. Although this type of procedure is simple and does not consume large quantities of calibration gases, calibration was also conducted across the whole system, i.e., injection at Point "A". This procedure is the correct and preferred method of calibrating a system but is not widely used due to the inherent high consumption of calibration gases. Calibration at Point "A" was conducted twice during the survey while injection at Point "B" was carried out twice a day.

Leak checks were conducted prior to and at the end of each test by capping the water knock-out bottle and subjecting the system to a vacuum of 23 inches of mercury. The sample pump was then turned off and the vacuum drop noted for two minutes. Any drop in vacuum during this period indicated a leak in the portion of the system under vacuum.

All the signals from the analyzers were recorded on a multi-point recorder. Usually a data logger is used for collecting data, however, the dusty conditions at the site precluded the use of this instrument.

5.4 Process Streams

Process samples were also collected during the sampling runs. Three process streams were sampled:

- 1 - scrubber inlet water
- 2 - scrubber outlet water
- 3 - coal feed to dryer.

Grab samples were taken at one-hour intervals from each of the process streams. Typically, a 5-gallon pail of sample was collected for each stream every run. At the end of each run, each sample was well mixed and a representative portion taken and stored in

a clean glass mason jar. All process samples were returned to Ottawa. In Ottawa, a composite coal sample was made up from the four daily coal samples and submitted to two labs for multi-element, proximate and ultimate analysis. The scrubber solutions were not analyzed due to a lack of funds.

6 ANALYTICAL METHODOLOGIES

All the samples from the organic trains were submitted to the ASD for dioxin, furan, PAH and PCB analysis. A description of the extraction procedures for the different sample matrices, clean-up methods, screening and analysis are outlined in Appendix II.

The loaded glass fibre filters and the front-half wash residues from the first four runs were forwarded by the ASD to Bondar-Clegg, a local laboratory, for heavy metals analysis. The filter and residue from the fifth particulate/heavy metals run were sent to NEA, Inc. (Beaverton, Oregon) for the analysis of heavy metals, organic and elemental carbon. Impinger solutions from the particulate trains were analyzed by the ASD for chloride ion using ion chromatography.

The coal composite was submitted to Energy, Mines and Resources (E.M&R) and Bondar-Clegg for multi-element, proximate and ultimate analysis. In addition, a National Bureau of Standards (NBS) reference coal sample was sent to each of these labs to determine accuracy and precision. All inorganic results including comparisons between different labs are detailed in an internal ASD report contained in Appendix II.

7 RESULTS

7.1 Particulates

The summary of the particulate results is given in Table 3. Sampling was conducted on the west stack only. Particulate concentrations ranged from 283 to 615 mg/m³ or 0.12 to 0.27 grains/ft³. Average loading was 467 mg/m³ or 0.20 grains/ft³. Emission rates varied between 77 and 153 kg/h or 1.85 to 3.68 tonnes/day. The emission data is summarized in the following table.

SUMMARY OF PARTICULATE DATA (WEST STACK)

	Range	Mean	Standard Deviation
CONCENTRATION			
mg/m ³	283 - 615	467	127
grains/ft ³	0.12 - 0.27	0.20	0.06
EMISSION RATES			
kg/h	77 - 153	119	29
tonnes/day	1.85 - 3.68	2.85	0.70

Gaseous hydrogen chloride was also determined for each run by measuring the chloride ion concentration in the distilled water from the impingers. Hydrogen chloride concentrations were very low ranging from 0.012 to 0.030 ppm. The average concentration was 0.02 ppm.

7.2 SO₂, NO_x, CO, THC and O₂

The continuous monitoring results for SO₂, NO_x, CO, THC and O₂ are given in Table 4. The daily concentrations for each pollutant represent averages of the 15-minute averages. Range, mean and standard deviation of the daily values for each constituent are summarized in the following table.

TABLE 3 SUMMARY OF PARTICULATE RESULTS

ELKVIEW PLANT - WESTAR - DRYER PLANT - WEST STACK					
GENERAL DATA					
Run Number	P-1	P-2	P-3*	P-4	P-5
Date (1984)	Sept. 8	Sept. 9	Sept. 10	Sept. 11	Sept. 12
Time	1018-1330	1241-1705	1738-1901	1405-1738	1158-1559
Test Duration (min)	192	240	83.1	192	240
Total Sample Vol (m ³)	3.374	4.230	1.564	3.575	4.731
Isokineticity (%)	100.9	97.4	98.2	99.9	99.8
STACK GAS CHARACTERISTICS					
Average Velocity (m/s)	12.62	13.09	12.93	12.89	13.71
Flowrate (m ³ /min)	3996	4154	4398	4278	4531
Temperature (°C)	44.3	47.1	36.0	38.6	40.0
Moisture (%)	10.92	9.81	6.93	7.89	8.59
Oxygen (%)	18.7	18.2	19.2	19.2	19.2
Carbon Dioxide (%)	1.3	1.5	0.9	0.6	0.8
PARTICULATE CATCHES					
Probe Wash (mg)	1038.3	1526.5	367.8	774.5	593.7
Filter (mg)	738.7	1072.7	427.4	668.5	746.7
Total (mg)	1777.0	2599.2	795.2	1443.0	1340.4
PARTICULATE CONCENTRATION					
Total (mg/m ³)	526.8	614.6	508.4	403.7	283.4
Total (grains/ft ³)	0.23	0.27	0.22	0.18	0.12
PARTICULATE EMISSIONS					
Hourly (kg/h)	126.3	153.2	134.2	103.6	77.0
Daily (tonnes/day)	3.03	3.68	3.22	2.49	1.85

- All volumes given at dry standard conditions (25°C and 101.3 kilopascal)

- O₂ and CO₂ expressed on a dry basis

- Moisture - Saturation Value

* Incomplete run due to plant shutdown

TABLE 4 SUMMARY OF CONTINUOUS SO₂, NO_x, CO, THC AND O₂ RESULTS

ELKVIEW PLANT (WESTAR) - DRYER PLANT - WEST STACK					
Run No.	1	2	3	4	5
Date (1984)	Sept. 8	Sept. 9	Sept. 10	Sept. 11	Sept. 12
Time	1015-1330	1245-1900	1730-1900	1400-1730	1200-1600
SO ₂ (ppm)	4	9	5	4	6
NO _x (ppm)	2	6	2	2	2
CO (ppm)	260	170	280	340	310
THC (ppm)	530	44	1220	1230	540
O ₂ (%)	18.7	18.2	19.2	19.2	19.2

All values represent averages of 15-minute averages

SUMMARY OF CONTINUOUS MONITORING CONCENTRATIONS

	Range	Mean	Standard Deviation
SO ₂ (ppm)	4-9	5.6	2.1
NO _x (ppm)	2-6	2.8	1.8
CO (ppm)	170-340	272	65
THC (ppm)	44-1230	713	509
O ₂ (%)	18.2-19.2	18.9	0.4

7.3 Heavy Metals

The stack gas concentrations and emission rates for Al, Ca, Fe, K, Mg, Na, P, S and Si, are given in Table 5. Heavy metal results for run P-5 were not available at the time of writing. On average, silicon represented the largest component of the elements analyzed followed by aluminum, sulphur, calcium and iron. Phosphorous represented the smallest component. A summary of the mean and standard deviation for each metal for the four runs are summarized in the following table.

SUMMARY OF HEAVY METAL DATA (WEST STACK)

	CONCENTRATION (mg/m ³)		EMISSION RATE (g/h)	
	Mean	Standard Deviation	Mean	Standard Deviation
Al	8.59	3.56	2154	860
Ca	1.35	0.26	338	63
Fe	1.07	0.26	268	64
K	0.56	0.30	139	71
Mg	0.67	0.22	167	50
Na	0.16	0.09	41	25
P	0.09	0.01	22	4
S	1.78	0.36	446	77
Si	19.10	3.08	4807	712

TABLE 5 SUMMARY OF HEAVY METAL RESULTS

ELKVIEW PLANT - WESTAR - DRYER PLANT - WEST STACK											
P-1			P-2		P-3		P-4		Average		
	mg/m ³	g/h	mg/m ³	g/h	mg/m ³	g/h	mg/m ³	g/h	mg/m ³	g/h	
Al	11.04	2647	10.92	2721	8.96	2364	3.45	885	8.59	2154	
Ca	1.35	323	1.67	415	1.33	351	1.03	264	1.35	338	
Fe	1.10	264	1.38	345	1.04	275	0.74	189	1.07	268	
K	0.76	183	0.86	214	0.32	84	0.29	73	0.56	139	
Mg	0.93	222	0.61	152	0.71	187	0.41	105	0.67	167	
Na	0.13	31	0.12	29	0.29	78	0.11	27	0.16	41	
P	0.07	17	0.08	20	0.10	27	0.09	24	0.09	22	
S	2.15	516	2.01	501	1.57	413	1.38	353	1.78	446	
Si	21.49	5153	20.46	5100	19.83	5232	14.58	3742	19.09	4807	

Concentrations expressed at dry standard conditions (25°C and 101.3 kilopascal)
 Results for P-5 are not available

7.4 Organics

7.4.1 Dioxins/Furans. The dioxin and furan emission results for three runs are presented in Table 6. Dioxins were detected in all three runs and furans were only detected in the last two runs. The average dioxin and furan concentration and emission rates are given in the following table.

SUMMARY OF DIOXIN AND FURAN DATA (WEST STACK)

	Concentration (ng/m ³)	Emission Rate (μg/h)
Dioxins	2.19	641
Furans	1.67	165

No particulate/gaseous split or train efficiency data was available for these runs since all the sample extracts from each run were combined into one. This was done to increase the detectability of the dioxins and furans for each run. Initially, analyses performed with the GC/MSD which has a detection limit of 2-5 ng per isomer detected dioxins and furans in only a few samples. Hence, the individual sample extracts from each run were combined and a more sensitive analytical technique (GC/MS) was used (detection limit was 0.1 to 0.5 ng per isomer). As a result, dioxins and/or furans were detected in all three runs. Furans were detected in the tetra and hepta isomer groups whereas dioxins were found in the penta, hexa and octa homologues.

7.4.2 Polyaromatic Hydrocarbons. Two runs were conducted for polyaromatic hydrocarbons (PAH's), as described in Table 7. The same train was also used for the determination of polychlorinated biphenyls (PCB's). In total, 25 organic compounds were determined. These ranged from molecular weights of 152 to 197. Almost all the compounds were detected in both runs. The concentration and emission rates for both runs are shown in Table 8.

The average PAH concentrations for the first and second runs were 56.81 and 33.37 μg/m³. Emission rates were 17.35 and 12.01 g/h respectively. In descending order, phenanthrene, anthracene, chrysene, benz (A) anthracene, benz (A) fluorene, 2-ME-fluorene and fluorene represented the majority of the PAH's analyzed for both runs. These seven compounds accounted for 69% of the total PAH's in the first run and 61% in the second test. Although the heavier molecular weight compounds were detected, the bulk of the PAH's were found in the low to mid-range molecular weight groups i.e. acenaphthylene to chrysene.

TABLE 6 SUMMARY OF DIOXIN AND FURAN RESULTS

ELKVIEW PLANT - WESTAR - DRYER PLANT - <u>WEST</u> STACK			
GENERAL DATA			
Run Number	DF-1	DF-2	DF-3
Date (1984)	Sept. 8	Sept. 9	Sept. 12
Time	1018-1440	1235-1715	1158-1600
Test Duration (min)	192	240	240
Total Sample Vol (m ³)	3.026	2.769	3.038
Isokineticity (%)	99.8	104.8	102.9
STACK GAS CHARACTERISTICS			
Average Velocity (m/s)	14.58	14.24	14.94
Flowrate (m ³ /min)	4683	4491	5021
Temperature (°C)	42.7	44.4	37.8
Moisture (%)	10.10	11.13	7.66
Oxygen (%)	18.7	18.2	19.2
Carbon Dioxide (%)	1.3	1.5	0.8
TRAIN CATCHES*			
Dioxins (ng)	4.4	2.3	13.0
Furans (ng)	0	0.7	4.3
CONCENTRATION			
Dioxins (ng/m ³)	1.45	0.83	4.28
Furans (ng/m ³)	ND	0.25	1.42
EMISSION RATES			
Dioxins (µg/h)	408.6	223.8	1289.1
Furans (µg/h)	ND	68.1	426.4

- All volumes given at dry standard conditions (25°C and 101.3 kilopascal)
 - O₂ and CO₂ expressed on a dry basis
 - Saturation value is given for % moisture
 - * Train catches have been recovery corrected for the labelled isotope standards. No dioxins and furans were detected in the blank train and the reagent blanks
- ND not detectable

TABLE 7 SUMMARY OF TRAIN AND STACK DATA - PAH RUNS

ELKVIEW PLANT - WESTAR - DRYER PLANT - WEST STACK		
GENERAL DATA		
Run Number	PAH/PCB-1*	PAH/PCB-2
Date (1984)	Sept. 10	Sept. 11
Time	1738-1901	1405-1738
Test Duration (min)	82.5	192
Total Sample Vol (m ³)	1.792	3.822
Isokineticity (%)	97.5	92.2
STACK GAS CHARACTERISTICS		
Average Velocity (m/s)	14.69	14.72
Flowrate (m ³ /min)	5089	6005
Temperature (°C)	33.6	35.6
Moisture (%)	5.98	6.85
Oxygen (%)	18.5	18.5
Carbon Dioxide (%)	1.5	1.5
- All volumes given at dry and standard conditions (25°C and 101.3 kilopascal) - O₂ and CO₂ expressed on a dry basis - Saturation value is given for % moisture * Incomplete run due to plant shutdown		

TABLE 8 SUMMARY OF PAH RESULTS - WEST DRYER STACK

Compound	RUN PAH/PCB-I		RUN PAH/PCB-2	
	Concentration ($\mu\text{g}/\text{m}^3$)	Emissions (mg/h)	Concentration ($\mu\text{g}/\text{m}^3$)	Emissions (mg/h)
Acenaphthylene	0.11	34.08	0.53	189.48
Acenaphthene	0.86	262.40	1.46	526.03
Fluorene	3.38	1030.86	1.93	694.77
2-ME-Fluorene	3.53	1078.57	2.09	753.22
Phenanthrene	9.61	2935.83	4.75	1710.06
Anthracene	6.72	2053.21	3.95	1423.48
Fluoranthene	2.50	763.35	1.42	510.00
Pyrene	2.41	734.38	1.39	500.57
Benzo (A) Fluorene	4.71	1438.10	2.08	750.39
Benzo (R) Fluorene	2.39	730.97	1.11	398.76
3-ME-Pyrene	2.30	702.01	1.13	406.30
Benzo (G,H,I) Fluoranthene	0.17	51.12	0.24	87.67
Benzo (A) Anthracene	5.61	1714.13	2.71	976.64
Chrysene & Triphenylene	5.79	1768.66	2.82	1015.29
2-ME-Benzo (A) Anthracene	0.11	32.37	ND	ND
B (B) F & B (K) F	1.86	569.10	1.31	471.35
Benzo (E) Pyrene	1.74	531.62	1.75	628.78
Benzo (A) Pyrene	1.70	517.99	1.09	392.16
Perylene	0.36	110.75	ND	ND
ME-Cholanthrene	ND	ND	0.10	34.88
O-Phenylene Pyrene	ND	ND	0.13	46.19
Dibenzo (A,C) & (A,H) Anthracene	0.17	51.12	0.27	97.10
Benzo (B) Chrysene	0.53	161.87	0.30	107.47
Benzo (G,H,I) Perylene	0.25	76.68	0.57	206.45
Anthanthrene	ND	ND	0.24	84.84
TOTAL	56.81	17 349.17	33.37	12 011.88

ND - not detectable

No PAH's were detected in the blank train and reagent blanks

The portion of the PAH's found as particulates represented 84 and 61% of the total PAH catch for the first and second runs respectively. Usually these compounds are predominantly found in the gaseous phase but the high particulate loading at this site promoted the removal of PAH's through the interaction between the gaseous organic and the carbonaceous dust particles. Breakthrough was detected for 3 PAH compounds in the second run only.

7.4.3 Polychlorinated Biphenyls

Polychlorinated biphenyls were also determined from the PAH/PCB train samples. The emission results should be regarded as qualitative in nature as excessive contamination of the XAD-2 in the blank train samples was noted. Based on the data, it is suspected that contamination occurred either before or after the survey. It was unlikely that the Amberlite was contaminated in the field since this component requires practically no sample handling or transfer in the field. With respect to the train efficiency for PCB's, some breakthrough into the first ethylene glycol impinger was detected but none was found in the second glycol impinger.

The concentrations for the first and second runs were 391 and 165 ng/m³ respectively. Emission rates were 119 and 59 mg/h respectively. Again, these results should be regarded as qualitative due to suspected contamination.

8 DISCUSSION

The test program was conducted to characterize the emissions from a gas-fired metallurgical coal dryer and to evaluate the effectiveness of the organic sampling train. As explained earlier in Section 5, stack samples for each train were collected along two traverses along the same axis, not along perpendicular axes. The difference between the two sampling axes is reflected in the standard stack gas flowrate. Flowrates on the north port (organic train) were consistently higher than those measured on the west port (particulate train). The average flowrate at the north port was 18% higher than that measured through the west port.

There was mixed success with the various groups of organic compounds in the organic train. For the dioxins and furans, the extracts were combined to obtain a total for each run hence the particulate/gaseous split, scrubbing efficiency and effectiveness of the rinsing procedures cannot be assessed. No detectable quantities were found in the blank train samples, resin blank and the individual reagent blanks. With respect to the PAH compounds in the PAH/PCB train, distribution data indicated good adsorption efficiency by the XAD-2 and effective rinsing procedures. No PAH's were detected in the condensate trap indicating good percolation efficiency. Breakthrough of organics into the ethylene glycol was noted for three PAH compounds in the second run - no breakthrough was noted in the first run. All blank train samples and blank reagents contained sub-detectable levels. In the case of PCB's, however, the results should be regarded as inconclusive due to excessive levels of PCB's found in the blank train. Considering the complexity and different characteristics of the organic compounds analyzed, the organic sampling train was effective for measuring dioxins, furans and polyaromatic hydrocarbons.

APPENDIX I

DETAILED PLANT DESCRIPTION

ELKVIEW COAL PREPARATION PLANT

Plant Location	East Kootenay area, S.E. British Columbia
Coal Field	Crows Nest
Coal Rank ISO ASTM	4 Medium volatile bituminous
Commissioned	1970
Feed Capacity (tonnes per hour)	1600
Plant Recovery, %	76
Clean Coal Production (10 ⁶ tonnes per year, 83)	6.0 metallurgical
Typical % minus 0.6mm	35
Typical Clean Coal Analysis	
% Ash	9.5 ± 0.5
% Total moisture	8.0
% Volatile matter	19 - 22
% Sulphur	0.4
FSI	6-8
Unit Processes (Size range of feed, mm)	
Heavy medium vessels	100 x 6
Heavy medium cyclones	6 x 0.6
Jig	—
Autogenous medium cyclones	0.6 - 0
Froth flotation	0.15 - 0
Fine coal dewatering	Rotary vacuum disc filter
Thermal dryer	Fluid bed 6 x 0
Fine rejects dewatering	Lagoon

ELKVIEW COAL PREPARATION PLANT

The plant, located near Sparwood, British Columbia, is operated by Westar Mining Ltd., owned 67% by the British Columbia Resources Investment Corporation (BCRIC) and 33% by Mitsubishi Corporation and nine Japanese steel mills. The company also operates the Roberts Bank coal port, some 30 km (20 miles) south of Vancouver, British Columbia.

Nearly 90 per cent of the raw feed coal comes from open pits (shovel and truck) and is conveyed through a mountain tunnel to the preparation plant feed silos. The remainder is brought to site by trucks from a nearby underground hydraulic mine. After cleaning and drying, the coal is hauled in 108 car unit trains by CP Rail, some 1125 km (700 miles) to Roberts Bank for shipment mainly to Japanese steel mills.

Coal Preparation Plant, Layout and Development

When commissioned in 1970, with a capacity of 1200 tonnes per hour, this was probably the largest plant in the world. The plant layout is similar to that frequently used in the Appalachians (eastern U.S.A.), building on the mountainside so as to minimize the conveyor lengths between process stages.

More and dirtier fines were found than anticipated at the design stage, and a series of major modifications to the plant were made in the early seventies. By completion, the plant capacity had been increased in 1600 tonnes per hour. The plant can be operated as two separate streams. This, together with a high standard of maintenance, results in actual production hours well in excess of 6000 hours per year.

Basic Plant Circuit

Basic details of the plant are given in Table 2 and on the flowsheet. Coarse coal (100 x 6 mm) is cleaned in Roberts and Schaeffer Barvoys heavy medium (magnetite) vessels, small coal (6 x 0.6 mm) in DSM heavy medium (magnetite) cyclones. The fines cleaning circuit is described in some detail below. After mechanical dewatering, the 6 mm x 0 cleaned coal is dried in a twin FMC Link Belt fluid bed dryer with a total evaporative capacity of 90 tonnes per hour.

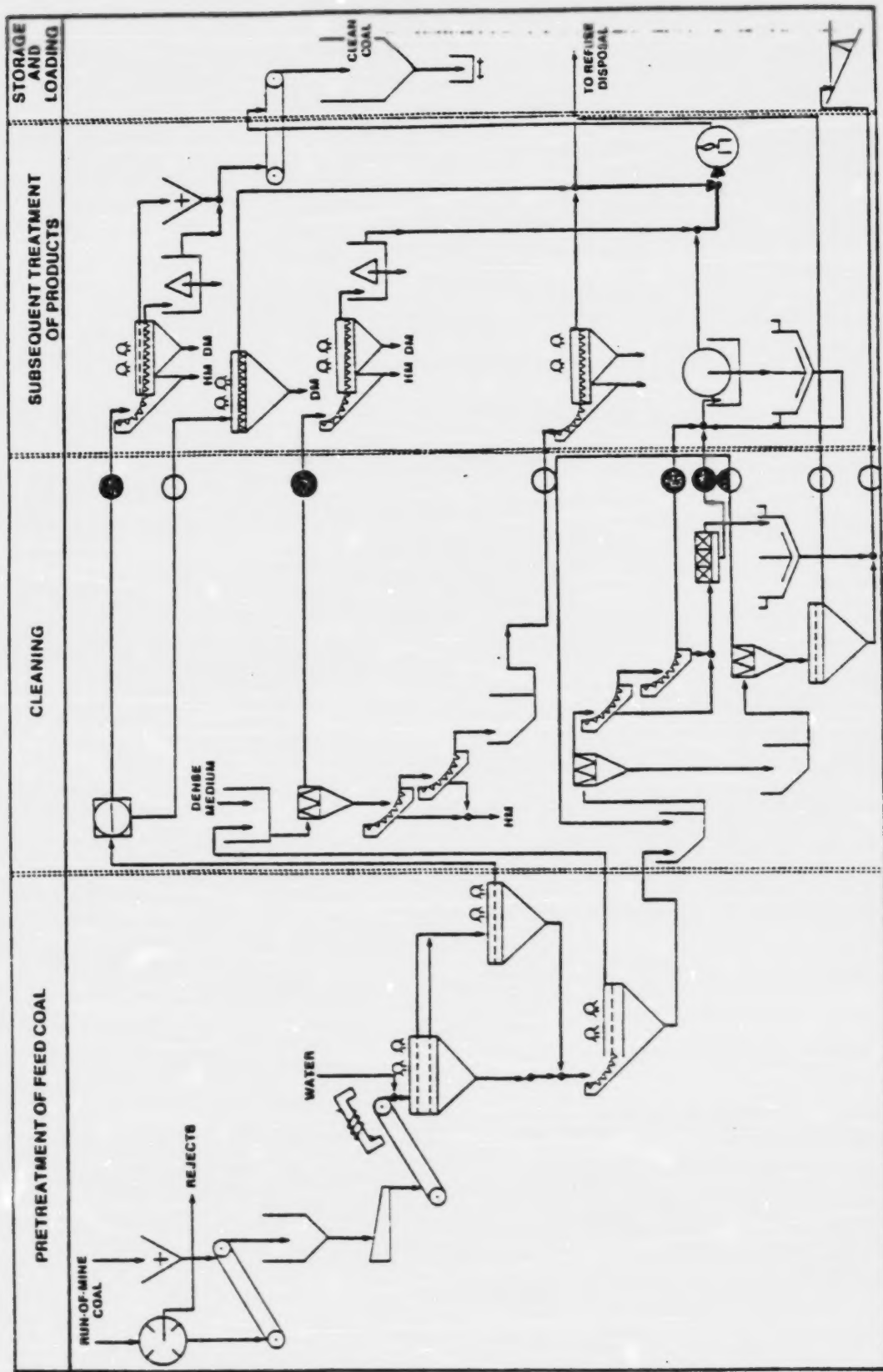
Fines Cleaning Circuit

The original design incorporated DSM water-only washing cyclones and Wemco open trough flotation cells for fines cleaning. This circuit has undergone considerable evolution and is now the largest (600 tonnes per hour) fines cleaning circuit of this type. Two stages of cyclones are used: primary cyclone overflow is product; secondary cyclone overflow is returned to the circuit feed sump.

Whilst the water-only washing cyclones gave a useful gravimetric separation of the 0.6 x 0.15 mm size fraction, it was found that classifying cyclones were not an accurate means of removing the 0.15 mm x 0 slimes from the coarser particles. After trials with various alternatives, the present design of long life vibrated sieve bends was developed on this plant.

Water Clarification Circuits

This plant uses two clarifier-thickeners. From the tailings thickener the underflow is discharged to the tails lagoons. The clean coal thickener is used to provide a consistent feed of 0.6 mm x 0 cleaned coal to the rotary vacuum disc filters.



COAL PREPARATION PLANT AT ELKVIEW, BRITISH COLUMBIA.

APPENDIX II

ANALYTICAL METHODS AND REPORTS

INORGANIC ANALYSIS OF SAMPLES FROM 1984 BRITISH COLUMBIA COAL
PREPARATION PLANTS SURVEY.

Internal report
by
J. F. Dlouhy
May, 1985
Ottawa

Analytical Services Division
River Road Environmental Technology Centre
Department of the Environment

Introduction

Samples for the analysis from the 1984 survey of two British Columbia coal preparation plants were received from the Pollution Measurement Division in 1984 and 1985. A similar analysis was performed in 1983. Due to different circumstances most of the work was done externally. The coal samples were analyzed at the Department of energy, mines and resources (EMR), Energy Research Laboratories, Bells Corners Complex and at Bondar-Clegg & Co. (B-C), Ottawa. The filters were analyzed at Bondar-Clegg. On the request of the customer two filters and a blank were send for analysis to NEA Inc., Beaverton, Oregon. Despite of repeated requests no results were received up to now. Probe washes were analyzed at Bondar-Clegg. Impinger contents were analyzed at Analytical Services Division (ASD). Request for the analysis by an external contractor was not accepted due to the too low chloride content. Samples were analyzed for different metals and nonmetals. On coals some other parameters were measured as well. Only the impinger contents were analyzed for chloride exclusively. The quality control was performed by the use of NBS standards and ASD standards. The ASD standards were either previously analyzed samples or samples prepared from standard solutions. The experimental work at ASD was done by Nicole Houle and Dr. Joseph F. Dlouhy.

Coal

Two composite samples were analyzed at the Department of energy, mines and resources (EMR) and at Bondar-Clegg (B-C). Results from both laboratories are in Table 1 which includes the ratios between B-C and EMR results as well. The ratios indicate the reliability of the results. It is an indirect measure of accuracy and precision. Four results in either one of the laboratories are dubious. The dubious results are one for Na, two for S and one for Si.

Two National Bureau of Standards coal samples were analyzed in both laboratories in order to ascertain the accuracy and precision. The results are in Table 2. There is one outlier present in the results for each laboratory. Two other coals from a previous survey which were already analyzed before at EMR, Atomic Energy of Canada and at Analytical Services Division were reanalyzed at EMR and newly analyzed at B-C. Table 3 contains the ratios between the old and new EMR results and the mean ratios. There are two outliers present for each sample. One for Na, two for P and one for Sr. Table 4 contains the ratios between B-C and EMR results for all six samples. There is a double outlier for P for Coal Valley samples. The presence of outliers is caused by errors in both laboratories. For the purpose of coal composition in Table 1 the Na error is assigned to B-C and the S errors are assigned to EMR results. The second S results line analyzed also at EMR by a wet method gives more satisfactory results and should be used. The EMR values are preferred in order to maintain

compatibility with S speciation results. The error assignment for Si can't be done. One laboratory is using the XRF method and has an error for S for the same method. The second laboratory is using a wet method, which for large quantities of Si easily causes a positive error, which is the case. There is the systematic bias for the moisture determination. The EMR results should be used. The ash EMR results from our past experience agreed to 0.06%. The EMR results should be therefore used. For C the EMR values should be used on account of very good agreement with the previous results. For all other results the mean value, where applicable, between B-C and EMR results should be used. Such values are presented in Table 5.

Filters

The quartz filter is superior to the glass fiber filter in composition for major elements Al, Ca, K, Mg and Na as can be seen in Table 6. The ratio for the blank element loading for these elements is better than 10:1 for the quartz filter. That causes higher precision and accuracy for the above named elements in quartz filter experiments.

The quartz filter was used only for filter sample #109. All other samples were collected on glass fiber filters. The net loadings in mg/filter are in Table 7. It contains all results including the negative values. These are caused by eventual contamination, lack of precision and accuracy, overall particulate loading and filter elemental composition. Table 8 contains the filter numbers with usable net filter loading values in the previous table. The criterion was >10% particulate element loading to filter element content. The inclusion of Al and Si results for samples with numbers higher than 400 is caused by about one order of magnitude larger particulate loadings than for other filters. Na loading for all filters was too low even for the quartz filter.

Probe washes

Probe washes were available as evaporated samples in 50 mL glass beakers. They were delivered to Bondar-Clegg and analyzed after digestion. From one sampling location the mean amount of probe washes was 69 mg. Two standards were prepared at ASD which contained seven major elements. The results are in Table 9. Both values for Na are obviously wrong. That was caused by the large amount of Na in the reagent blank. The difference between the given and the found values indicates 126.3% recovery for Na. The mean recovery for all seven elements is 106.0%. The results for all samples are in Table 10 and Table 11.

Impingers

The impinger content was supposed to be analyzed for the chloride at one contractor. That was rejected by the contractor after communication of ASD preliminary concentration results. All concentrations were below the detection limit for the methods used by the contractor. The analysis was then performed at ASD using the ion chromatography. The results are in Table 12. Different detection limits are caused by different volume of impinger content.

Table 1
Coal composition

Element or parameter	Bullmoose composite			Elkwood composite		
	EMR [%]	B-C [%]	Ratio [%]	EMR [%]	B-C [%]	Ratio [%]
Al	0.955	0.98	102.6	1.465	1.44	98.3
Ba	0.133			0.0164		
Ca	0.343	0.31	90.4	0.201	0.11	54.7
Fe	0.237	0.18	75.9	0.197	0.14	71.1
K	0.0593	0.05	84.3	0.0423	0.03	70.9
Mg	0.105	0.09	85.7	0.0522	0.04	76.6
Na	0.0607	0.06	98.8	0.0106	0.02	188.7
P	0.0334	0.04	119.8	0.0325	0.04	123.1
S	0.164	0.32	195.1	0.0906	0.26	287.0
Si	2.23	6.52	292.4	2.81	2.31	82.2
Sr	0.0124			0.00431		
Ti	0.113			0.106		
LOF	0.127			0.0805		
C	80.09	64.70	80.8	79.67	65.30	82.0
ash	8.61	8.05	93.5	10.19	9.88	97.0
moisture	0.60	0.36	60.0	0.42	0.28	66.7
volatile	25.77			21.18		
fixed carbon	65.02			68.21		
H	4.54			4.28		
S	0.38	0.32	84.2	0.30	0.26	86.7
N	1.24			1.30		
O (by difference)	4.54			3.84		
heat value [cal/g]	7798			7728		
S (sulphate)	0.00			0.00		
S (pyritic)	0.05			0.06		
S (organic)	0.33			0.24		

Notes: EMR Department of energy, mines and resources
B-C Bondar-Clegg Co. Ottawa
Ratio B-C/EMR
LOF loss on fusion
fixed carbon (by difference)

Table 2
NBS coal standards recovery

Laboratory	EMR	EMR	B-C	B-C	mean	s	n
Sample #	1632a	1635	1632a	1635			
Element	[%]	[%]	[%]	[%]	[%]	[%]	
Al	92.9	92.5	94.2	84.4	91.0	4.46	4
Ca	101.7		87.0		94.4		2
Fe	101.8	87.9	87.4	87.9	91.2	7.04	4
K	93.6		85.7		89.6		2
Mg	130.0		100.0		115.0		2
Na	132.1	91.7	119.0	(35.7)	114.3	20.61	3
S	(8.61)	73.0	88.6	69.7	77.1	10.10	3
Ti	87.2	103.5			95.4		2
mean	105.6	89.7	94.6	80.7			
s	18.13	11.00	11.90	9.66			
n	7	5	7	3			

Notes: EMR Department of energy, mines and resources
 B-C Bondar-Clegg
 () outliers not included in means etc.
 s standard deviation
 n number of elements

Table 3
Coal Valley coal samples 1982
1983/1985 EMR results ratios

Sample Element	#1 [%]	#2 [%]	mean [%]
Al	101.6	102.6	102.1
Ca	102.7	97.4	100.0
Fe	100.5	96.3	98.4
K	100.7	99.0	99.8
Mg	79.9	103.4	91.6
Na	92.4	(168.1)	92.4
P	(418.3)	(144.8)	
S	121.2	90.1	105.6
Si	101.1	104.1	102.6
Sr	(63.3)	83.8	83.8
Ti	107.3	105.6	106.4
mean	100.8	98.0	98.3
s	11.01	7.19	7.05
n	9	9	10

Notes: EMR Department of energy, mines and resources
s standard deviation
n number of elements
() outliers not included in means etc.

Table 4

Coal results

Bondar-Clegg/EMR results ratio

Sample	NBS 1632a [%]	NBS 1635 [%]	Coal valley #1 [%]	Coal valley #2 [%]	Composite 1) [%]	Composite 2) [%]	mean [%]	s [%]	n
Element									
Al	101.4	91.2	100.0	93.3	102.6	98.3	97.9	4.47	6
Ca	85.5	98.4	99.1	89.5	90.4	(54.7)	92.6	5.93	5
Fe	85.8	101.0	87.3	83.1	75.9	71.1	84.0	10.35	6
K	91.6	78.1	82.2	68.5	84.3	70.9	79.3	8.64	6
Mg	76.9	116.3	100.5	82.7	85.7	76.6	89.8	15.65	6
Na	90.1	(40.9)	92.4	87.7	98.8	(188.7)	92.2	4.77	4
P	(1052.6)	(917.4)	(859.6)	(240.0)	119.8	123.1	121.4		2
S	(1029.4)	94.3	113.2	143.6	(195.1)	(287.0)	117.0	24.87	3
Si	84.0	66.3	92.1	76.5	(292.4)	82.2	80.2	9.58	5
C	83.6	84.6	80.9	82.3	80.8	82.0	82.4	1.50	6
ash	97.8	78.4	102.6	93.4	93.5	97.0	93.8	8.26	6
moist	58.9	80.3	76.0	71.6	60.0	66.7	68.9	8.62	6
mean	85.6	88.9	93.3	88.4	89.2	85.3			
s	11.78	14.34	11.08	20.05	16.21	17.98			
n	10	10	11	11	10	9			

Notes: EMR Department of energy, mines and resources

s standard deviation

n number of elements

moist moisture

1) Bullmoose

2) Elkwood

Table 5

Composite coals

Best available parameters

Element or parameter	Bullmoose [%]	Elkwood [%]
Al	0.968	1.452
Ba	0.133	0.0164
Ca	0.326	0.156
Fe	0.208	0.168
K	0.0546	0.0362
Mg	0.0975	0.0461
Na	0.0604	0.0106
P	0.0367	0.0362
Si	?	2.56
Sr	0.0124	0.00431
Ti	0.113	0.106
LOF	0.127	0.0805
C	80.09	79.67
ash	8.61	10.19
moisture	0.60	0.42
volatile	25.77	21.18
fixed carbon	65.02	68.21
H	4.54	4.28
S	0.38	0.30
N	1.24	1.30
O (by difference)	4.54	3.84
heat value	7798 [cal/g]	7728 [cal/g]
	32.65 [MJ/kg]	32.36 [MJ/kg]
S (sulphate)	0.00	0.00
S (pyritic)	0.05	0.06
S (organic)	0.33	0.24

Note: LOF loss on fusion

Table 6

Filter blanks

Element	#148 GFF	#500 GFF	#501 Quartz
	[mg/g]	[mg/g]	[mg/g]
Al	29.00	28.00	1.00
Ca	40.00	40.00	2.95
Fe	2.25	1.55	3.30
K	7.35	7.35	0.30
Mg	15.45	15.45	1.00
Na	107.00	107.00	6.40
P	0.07	0.06	0.54
S	2.88	3.28	8.16
Si	196.38	185.37	398.00

Note: GFF glass fiber filter

Table 7

Filters net loading
[mg/filter]

Sample #	109	120	131	142	145	409	420	431	442
Element									
Al	1.25	-1.04	0.96	0.42	1.48	19.95	27.48	10.07	12.33
Ca	0.96	-0.66	-15.09	0.13	2.70	0.94	1.63	0.76	0.71
Fe	0.38	1.40	2.11	1.79	2.43	1.43	2.41	0.91	1.15
K	0.28	-2.22	-0.60	-0.38	-1.90	0.88	0.92	0.16	0.32
Mg	0.18	-1.21	0.39	0.09	-0.07	1.01	1.00	0.61	0.52
Na	0.30	2.50	-2.54	-1.90	-4.51	-3.11	-1.09	0.24	-1.84
P	0.49	0.41	1.23	0.65	0.54	0.16	0.26	0.08	0.15
S	-4.90	2.55	2.96	1.70	3.27	3.89	3.09	1.24	2.04
Si	-4.96	8.93	3.63	4.93	8.79	33.86	31.19	17.61	26.97

Table 8

Filters

Element Usable information

Filter #

Al	109		409-442
Ca	109		
Fe	109	120-145	409-442
K	109		
Mg	109		
Na			
P	109	120-145	409-442
S		120-145	409-442
Si			409-442

Table 9

Probe wash standards

Bondar-Clegg results

Sample	#504 given	#504 found	#504 recovery	#505 given	#505 found	#505 recovery	mean recovery
Element	[μg]	[μg]	[%]	[μg]	[μg]	[%]	[%]
Al	650	680	104.6	9000	9200	102.2	103.4
Ca	430	400	93.0	6500	6120	94.2	93.6
Fe	390	420	107.7	5500	6000	109.1	108.4
K	70	40	57.1	450	240	53.3	55.2
Mg	70	80	114.3	1000	1020	102.0	108.2
Na	70	(3360) (4800)		450	(3840) (853.3)		126.3 1)
P	-	4 2)	-	-	4 2)	-	-
S	-	219 2)	-	-	159 2)	-	-
Si	2000	2781	139.0	2000	3099	154.9	147.0
							mean 106.0
							s 28.4
							n 7

Notes: 1) calculated from the difference between given and found values
 2) contamination?
 () values in parenthesis are outliers
 s standard deviation
 n number of elements

Table 10

Probe washes

Bondar-Clegg results

Sample #	108	119	130	141	144	158
	[μg]	[μg]	[μg]	[μg]	[μg]	[μg]
Element						
Al	520	1020	780	860	760	760
Ca	540	400	620	640	360	460
Fe	800	680	380	320	520	380
K	60	120	100	100	80	80
Mg	140	160	160	140	140	140
Na	200	200	180	420	240	220
P	54	54	66	54	50	42
S	203	263	186	318	164	88
Si	3314	3174	2603	2290	2758	3043
Total solids	74500	72700	70300	59600	69900	66800
Found as oxides	15.0%	16.1%	13.8%	16.3%	14.0%	15.1%

Table 11

Probe washes

Bondar-Clegg results

Sample #	408	419	430	441	452
	[μg]	[μg]	[μg]	[μg]	[μg]
Element					
Al	17300	18700	3940	10200	8520
Ca	3600	5420	1320	2960	2760
Fe	2280	3440	720	1480	1480
K	1700	2720	340	700	480
Mg	1120	1580	500	940	920
Na	440	500	220	380	320
P	75	80	80	184	88
S	3370	5417	1214	2882	2630
Si	38645	55359	13396	25146	21435
Total solids	1038300	1526500	367800	774500	593700
Found as oxides	13.2%	12.2%	11.9%	11.6%	13.0%

Table 12

Impinger content

ASD results [$\mu\text{g}/\text{impinger}$]

Sample #	Cl	Detection limit
1	<16	<16
110	201	<36
121	152	<36
132	72	<40
143	68	<38
146	93	<29
160	83	<46
410	98	<46
421	151	<47
432	67	<30
443	80	<36
454	83	<38

Note: ASD Analytical services division

**ANALYTICAL PROTOCOLS FOR THE DETERMINATION
OF PAH AND PCB IN STACK EMISSION SAMPLES**

**Analytical Services Division
Technical Services Branch
Environmental Protection Programs Directorate
River Road Environmental Technology Centre
Ottawa, Ontario.**

December 1983

Stack emission samples consist of (a) solid samples such as filter and adsorbent (XAD-2), and (b) liquid samples such as water, ethylene glycol and solvent washes.

All liquid samples were split in half before sample extraction while solid samples were split only after soxhlet extraction.

1. CHEMICAL AND GLASSWARE PREPARATION

Before use, the XAD-2, Na_2SO_4 , silica gel, glasswool, florisil and glassware had to be cleaned of contaminants.

The XAD-2 was first washed with deionized water then soxhlet extracted with a mixture of 50% acetone and hexane for 16 to 24 h. It was then oven dried at 100°C for 8 to 12 h.

The silica gel was cleaned in a large column by an elution of 500 mL methanol followed by 500 mL MeCl_2 . It was oven dried at 160°C for 16 to 24 h.

The Na_2SO_4 and glasswool were also cleaned in a column by an elution of 500 mL MeCl_2 followed by 500 mL hexane. They were oven dried for 8 h at 260°C .

The florisil was soxhlet extracted for 24 h with 500 mL hexane. It was subsequently oven dried overnight and then muffled at 650°C for 7 h.

All the glassware was washed with the detergent "Swipe" and rinsed with deionized water followed by acetone and hexane. It was finally heat-treated for 8h at 350°C .

2. PCB

2.1 Sample Extraction

2.1.1 Filter and Adsorbent (XAD-2)

Each sample was transferred into a glass fiber thimble in a glass soxhlet apparatus. The sample was extracted with 250 mL benzene at a cycle rate of 5 to 8 cycle/h for a period of 16 to

24 h. The benzene extract was dried by passing through anhydrous sodium sulfate, and concentrated to 5 mL by rotary evaporation under reduced pressure at 30°C. One hundred millilitres of hexane was added to the benzene and concentrated to 5 mL.

2.1.2 Water

The sample was extracted three times by shaking vigorously with 100 mL of hexane in a separatory funnel. The combined extract was dried by passing through Na_2SO_4 and concentrated to 5 mL on a rotary evaporator.

2.1.3 Ethylene Glycol

The sample was mixed with half amount of deionized water and extracted three times by shaking in a separatory funnel with 100 mL of hexane each time. The extract was dried and concentrated as described above.

2.1.4 Solvent Wash

Each wash sample was dried by passing through Na_2SO_4 and evaporated to 5 mL by rotary evaporator.

2.2 Clean Up

A column (22 mm ID) loaded with 35 g of florisil and 2 g of Na_2SO_4 was prewashed with 100 mL of hexane. The concentrated extract was transferred to the florisil column and eluted with 250 mL of hexane at a rate of 2 to 4 mL/min. The hexane eluent was evaporated at 1 to 2 mL on a rotary evaporator and then was transferred in a calibrated centrifuge tube and evaporated further. Final volume was made up before GC injection (usually 0.5 mL).

2.3 Analysis

Every sample extract was spiked with both hexachlorobenzene (0.1 ug/mL) and P,P'-DDE (0.2 ug/mL) as internal standards for the calculation of relative retention time.

The external PCB standard mixture (Arochlor 1242 + Arochlor 1260) was injected into the GC between every fourth sample injection.

GC CONDITIONS

Instrument: HP 5830A with EC detection
Column: 60 m x 0.25 mm durabound fused silica column
Oven Temperatures: 50°C hold 2 min., 20°C/min. to 150°C, 3°C/min. to 300°C and hold 4 min.
Injection Mode: Splitless for 1.5 min, inject at 0.3 min.

3. PAH

3.1 Sample Preparation

3.1.1 Filter and Adsorbent (XAD-2)

Each sample was soxhlet extracted with 250 mL of benzene for 24 h at a rate of 5 to 8 cycle/h for a period of 16 to 24 h. This was evaporated to 5 mL by rotary exaporation and subsequently solvent extracted.

3.1.2 Water

The sample was transferred into a separatory funnel and extracted 3 times with 100 mL portions of benzene by vigorous shaking. The benzene extract was evaporated to 5 mL by rotary evaporation and then solvent extracted.

3.1.3 Ethylene Glycol

Each sample was diluted with half amount of deionized water and transferred to a separatory funnel. The liquid was extracted 3 times with 100 mL portions of benzene by vigorous shaking. The benzene extract was evaporated to 5 mL by rotary evaporation and subsequently solvent extracted.

3.1.4 Solvent Wash

Each sample was evaporated to 5 mL by rotary evaporation. One hundred milliliters of benzene was added to the 5 mL residue and evaporated to 5 mL, and then solvent extracted.

3.2 Solvent Extraction

About 20 mL of cyclohexane was added to the 5 mL benzene extract. The extract was shaken with three 20 mL portions of dimethyl sulfoxide (DMSO) in a separatory funnel. After shaking

the DMSO and cyclohexane were allowed to separate and the DMSO layers were kept and combined for further extraction. One hundred and twenty milliliters of water were added to the combined DMSO layer to remove acids and bases.

The PAHs were back extracted into cyclohexane by shaking the water and DMSO mixture twice with 40 mL portions of cyclohexane. The cyclohexane extracts were combined and washed with 150 mL of water. The cyclohexane was then dried by elution through anhydrous sodium sulfate (Na_2SO_4) and evaporated by rotary evaporation to about 10 mL for column clean-up.

3.3 Clean-Up

An activated silica gel column, 20 cm x 1 cm ID, consisting of 25 g of silica gel and 1 g of Na_2SO_4 was washed with 150 mL of hexane. After the sample was transferred to the column, it was eluted with 150 mL of hexane. The hexane eluent was discarded. PAHs were finally eluted with 150 mL of benzene. The benzene fraction was kept and evaporated to 1 to 2 mL by rotary evaporation.

Further concentration was performed with UHP nitrogen in a calibrated centrifuge tube at 20°C or air dried in a fumehood at 20°C. The volume was reduced to 0.5 mL for the analysis by gas chromatography.

3.4 Analysis

Every sample was made up to 0.5 mL and 1.0 μL was injected. Some of the samples were spiked with the mixture of PAH standard used for the analysis.

The PAH standard mixture was injected once a day before the samples.

GC CONDITIONS

Instrument: Varian-Vista 6000 with FID detector
Column: 30 m DB-5, fused silica, dia. 0.25 mm
Oven Temperatures: 90°C hold 3 min., 5°C/min. to 280°C,
hold 25 min.
Injection Mode: on-column, pre-cooled, 90°C, 180°C/min. to
280°C, hold 60 min.

**ANALYTICAL PROTOCOLS FOR THE DETERMINATION
OF PCDD/PCDF IN STACK EMISSION SAMPLES**

**Analytical Services Division
Technical Services Branch
Environmental Protection Programs Directorate
River Road Environmental Technology Centre
Ottawa, Ontario.**

December 1983

1. SAMPLE EXTRACTION

Stack emission samples consist of (a) solid samples such as filter and adsorbent (XAD-2), and (b) liquid samples such as water, ethylene glycol and solvent washes.

1.1 Filter and Adsorbent (XAD-2)

Each solid sample was Soxhlet extracted with 500 mL toluene at a cycle rate of 5 to 8 cycles/hr. for a period of 16 to 24 h. The toluene extract was dried by passing through anhydrous sodium sulfate, and concentrated to 1 mL by rotary evaporation under reduced pressure.

1.2 Water

Each aqueous sample was extracted three times with methylene chloride (100 mL, 2 x 50 mL) by shaking vigorously in a separatory funnel. The combined extract was dried by passing through Na_2SO_4 and reduced to 2 mL on a rotary evaporator.

1.3 Ethylene Glycol

The sample was mixed with an equal amount of deionized water and extracted three times with hexane (100 mL, 2 x 50 mL) by shaking vigorously in a separatory funnel. The combined extract was dried and concentrated as described above.

1.4 Solvent Wash

Each wash sample was dried by passing through Na_2SO_4 and evaporated to 2 mL by rotary evaporation.

2. CLEAN-UP

All extracts were chromatographed on a series of three columns. The first column contained 3 g of silica, 2 g of 33% 1M sodium hydroxide on silica and 4 g of 44% sulfuric acid on silica. The second one contained 1.5 g of 10% silver nitrate on silica, and the third column was packed with 2.5 g of freshly activated basic alumina. Most of the interfering compounds such as PCBs, chlorinated benzenes and sulfides were removed through these columns.

The concentrated sample after clean-up was transferred into a 0.5 mL amber vial and purged to dryness under a slow stream of nitrogen. Final volume was made up before GC injection (usually 0.1 mL).

3. ANALYSIS

PCDD and PCDF were identified and quantified by GC and GC/MS.

GC CONDITIONS

Instrument: HP 5830A with EC detection
Column: 60 m x 0.25 mm durabond fused silica column
Oven Temperatures: 70° hold 3 min., 20°C/min. to 210°C, 3°C/min. to 300°C and hold 15 min.
Injection Mode: Autoinjection, splitless for 1.5 min.

GC/MS CONDITIONS

Instrument: Finnigan 4500
Column: 60 m x 0.25 mm durabond fused silica column
Oven: 120°C hold 1 min., 15°C/min to 200°C, 2.5°C/min to 280°C and hold 30 min.
Injection: On column injection

MS - Carrier gas He for EI
- Ion source temperature 215°C
- Multiple ion detection for individual isomers

APPENDIX III

STACK TRAVERSE DATA

ELKHORN COAL PREP. PLANT, SPARKWOOD, EC.

SEPT. 6/64 10:18-13:30 PART #1

TRAVERSE DATA

TRAVERSE FT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H ₂ O)	ORIFICE PRESSURE (IN. H ₂ O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN OUT
					356.05	
24	4.0	113	0.290	0.860	357.97	54 53
23	4.0	111	0.270	0.810	360.09	56 53
22	4.0	117	0.200	0.590	361.99	61 53
21	4.0	109	0.370	1.110	364.35	67 55
20	4.0	114	0.370	1.100	366.86	69 54
19	4.0	113	0.380	1.140	369.33	75 56
18	4.0	111	0.450	1.480	372.02	78 58
17	4.0	115	0.410	1.230	374.58	82 55
16	4.0	114	0.400	1.210	377.10	83 61
15	4.0	114	0.630	1.910	380.12	85 62
14	4.0	116	0.630	1.910	383.22	85 64
13	4.0	117	0.630	1.910	386.32	92 66
12	4.0	120	0.620	1.870	389.41	92 67
11	4.0	117	0.630	1.920	392.52	93 69
10	4.0	111	0.640	1.980	395.68	95 70
9	4.0	109	0.740	2.300	399.16	96 71
8	4.0	114	0.630	1.940	402.24	98 72
7	4.0	109	0.650	2.030	405.38	99 74
6	4.0	109	0.650	2.160	408.69	99 75
5	4.0	111	0.660	2.060	411.94	101 76
4	4.0	109	0.600	1.880	415.11	102 77
3	4.0	109	0.550	1.730	418.13	102 78
2	4.0	111	0.470	1.480	420.92	103 79
2	4.0	109	0.450	1.420	423.67	102 80
2	4.0	108	0.440	1.390	426.38	102 81
2	4.0	108	0.440	1.450	429.12	102 82
3	4.0	116	0.500	1.560	432.08	102 81
4	4.0	111	0.580	1.830	434.95	103 82
5	4.0	115	0.590	1.850	438.03	104 82
6	4.0	112	0.700	2.210	441.35	105 83
7	4.0	111	0.670	2.120	444.63	107 84
8	4.0	111	0.710	2.250	448.01	108 84
9	4.0	111	0.690	2.190	451.41	110 85
10	4.0	110	0.680	2.170	454.77	110 86
11	4.0	112	0.650	2.060	458.04	111 86
12	4.0	110	0.650	2.080	461.33	111 87
13	4.0	108	0.650	2.080	464.55	110 87
14	4.0	115	0.640	2.030	467.84	112 87
15	4.0	112	0.650	2.070	471.14	112 88
16	4.0	110	0.670	2.140	474.48	112 88
17	4.0	115	0.640	2.030	477.63	112 88
18	4.0	110	0.650	2.080	481.12	113 89
19	4.0	112	0.620	1.980	484.34	113 90
20	4.0	111	0.610	1.960	487.55	112 90
21	4.0	112	0.590	1.880	490.66	112 89
22	4.0	111	0.540	1.730	493.78	113 90
23	4.0	113	0.490	1.560	496.68	111 89
24	4.0	111	0.420	1.340	499.37	110 89

AVERAGE 112 1.748 98 76

Ave. TEMPERATURE = 44.3 DEG. C

TOTAL SAMPLE TIME = 192.0 MIN.

TOTAL SAMPLE VOLUME = 119.127 SCF OR 3.374 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.89	OR	657.61	MM HG
PITOT TUBE FACTOR		0.734			
NOZZLE CALIBRATION FACTOR		0.973			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH	(GM)	1.03830			
WT. OF PART. ON FILTER	(GM)	0.73870			
WATER COLLECTED IN IMPINGERS	(ML)	304.3			

ANALYSIS OF ISOKINETICITY

TRAVERSE FT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
24	4.0	0.0096	0.0103	95.3
23	4.0	0.0107	0.0099	108.4
22	4.0	0.0097	0.0086	113.1
21	4.0	0.0118	0.0116	101.9
20	4.0	0.0126	0.0116	108.8
19	4.0	0.0123	0.0118	104.7
18	4.0	0.0133	0.0133	99.9
17	4.0	0.0127	0.0122	103.7
16	4.0	0.0124	0.0121	103.0
15	4.0	0.0143	0.0151	98.3
14	4.0	0.0152	0.0152	100.5
13	4.0	0.0152	0.0152	100.1
12	4.0	0.0152	0.0151	100.7
11	4.0	0.0152	0.0152	100.1
10	4.0	0.0152	0.0152	100.1
9	4.0	0.0167	0.0163	102.2
8	4.0	0.0143	0.0151	98.1
7	4.0	0.0150	0.0153	97.8
6	4.0	0.0158	0.0158	100.0
5	4.0	0.0155	0.0155	100.3
4	4.0	0.0150	0.0147	102.2
3	4.0	0.0143	0.0141	101.5
2	4.0	0.0132	0.0130	101.4
1	4.0	0.0130	0.0127	101.9
2	4.0	0.0126	0.0126	101.4
3	4.0	0.0129	0.0126	102.4
4	4.0	0.0141	0.0135	104.7
5	4.0	0.0136	0.0145	93.7
6	4.0	0.0147	0.0147	100.0
7	4.0	0.0157	0.0159	98.6
8	4.0	0.0155	0.0156	99.2
9	4.0	0.0159	0.0160	99.2
10	4.0	0.0160	0.0158	101.0
11	4.0	0.0157	0.0157	100.3
12	4.0	0.0153	0.0154	99.9
13	4.0	0.0154	0.0153	100.3
14	4.0	0.0150	0.0153	98.1
15	4.0	0.0155	0.0153	101.4
16	4.0	0.0154	0.0154	100.6
17	4.0	0.0156	0.0156	100.1
18	4.0	0.0148	0.0153	97.0
19	4.0	0.0163	0.0153	106.0
20	4.0	0.0150	0.0150	100.2
21	4.0	0.0150	0.0149	100.7
22	4.0	0.0146	0.0146	100.0
23	4.0	0.0144	0.0140	103.2
24	4.0	0.0136	0.0133	101.7
25	4.0	0.0126	0.0123	101.8

AVERAGE PERCENT ISOKINETICITY ACHIEVED 100.9

FLOW CONDITIONS DURING TEST

STACK AREA RT2	78.54	OR	7.30	SQR M
ABS. STACK PRESS.(IN. HG.)	25.86	OR	656.91	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY(FPS)	41.40	OR	12.62	M/S
GAS FLOW(ACFM-DRY)	173797	OR	4922	ACM/M
GAS FLOW(SCFM-DRY)	141088	OR	3996	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	16.48
CO2	1.50	1.34
CO	0.00	0.00
N2	80.00	71.26
H2O		10.92

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	3.289E-05	OR	5.268E-01	GM/SCM
LBS/ACF	2.379E-05	OR	3.810E-01	GM/ACM
GRAINS/SCF	2.302E-01			
GRAINS/SCF (12% CO2)	1.842E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	1.243E+00			
GRAINS/ACF	1.665E-01			
LBS/HR	2.784E+02	OR	1.263E+02	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

ELMWOOD COAL PREP. PLANT, SPANWOOD, EC.

SEPT. 9/64 12:41-17:05 PAR1.12

INVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F) IN OUT
1	5.0	121	0.390	1.130	499.50	56 55
2	5.0	119	0.480	1.400	502.60	61 55
3	5.0	117	0.530	1.550	506.00	69 56
4	5.0	117	0.540	1.580	509.58	74 57
5	5.0	115	0.590	1.740	513.15	78 59
6	5.0	115	0.620	1.840	516.63	83 61
7	5.0	118	0.600	1.770	520.58	85 63
8	5.0	121	0.620	1.830	524.31	88 65
9	5.0	120	0.630	1.870	528.12	90 67
10	5.0	118	0.620	1.860	531.95	93 70
11	5.0	121	0.560	1.680	535.75	94 72
12	5.0	122	0.580	1.740	539.40	96 73
14	5.0	120	0.610	1.840	543.11	97 76
14	5.0	118	0.600	1.820	546.94	99 77
15	5.0	118	0.620	1.890	550.77	100 79
16	5.0	118	0.620	1.890	554.62	101 80
17	5.0	120	0.660	2.010	558.41	104 81
18	5.0	123	0.620	1.890	562.42	106 83
19	5.0	123	0.620	1.890	566.33	106 84
20	5.0	118	0.660	2.020	570.08	84 80
21	5.0	111	0.620	1.920	574.08	93 80
22	5.0	122	0.540	1.640	578.00	96 80
23	5.0	115	0.530	1.630	581.65	98 81
24	5.0	119	0.510	1.560	585.26	96 81
24	5.0	120	0.500	1.530	588.86	100 82
23	5.0	119	0.490	1.500	592.33	101 83
22	5.0	114	0.580	1.790	595.83	100 82
21	5.0	119	0.540	1.650	599.29	101 82
20	5.0	118	0.590	1.810	603.05	101 82
19	5.0	114	0.610	1.810	606.86	100 82
18	5.0	118	0.570	1.740	610.76	97 81
17	5.0	115	0.640	1.960	614.57	95 80
16	5.0	117	0.640	1.960	618.52	97 79
15	5.0	112	0.650	2.000	622.45	98 79
14	5.0	117	0.610	1.870	626.42	101 80
13	5.0	116	0.650	1.990	630.09	99 79
12	5.0	113	0.680	2.090	633.67	101 79
11	5.0	113	0.620	1.910	637.78	106 80
10	5.0	112	0.590	1.820	641.75	106 80
9	5.0	110	0.690	2.130	645.58	107 81
8	5.0	117	0.620	1.900	649.62	106 82
7	5.0	116	0.660	1.990	653.47	107 82
6	5.0	113	0.660	2.050	657.44	108 83
5	5.0	116	0.620	1.910	661.47	109 84
4	5.0	117	0.570	1.760	665.43	112 84
3	5.0	116	0.570	1.760	668.64	110 85
2	5.0	113	0.540	1.680	672.20	108 85
1	5.0	113	0.520	1.620	675.66	109 85

AVERAGE 117 1.794 96 76

Ave. TEMPERATURE = 47.1 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 145.350 SCF OR 4.230 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.84	CR	656.34	MM HG
PITOT TUBE FACTOR		0.734			
FILTER CALIBRATION FACTOR		0.973			
NOZZLE DIAMETER	(IN.)	0.250	CR	0.350	MM
WT. OF PART. IN PROBE WASH	(GM)	1.52650			
WT. OF PART. ON FILTER	(GM)	1.07270			
WATER COLLECTED IN TYPICERS (ML)		338.3			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0126	0.0120	105.4
2	5.0	0.0137	0.0133	103.6
3	5.0	0.0143	0.0139	102.7
4	5.0	0.0142	0.0140	100.9
5	5.0	0.0145	0.0147	98.6
6	5.0	0.0147	0.0150	97.6
7	5.0	0.0146	0.0148	98.6
8	5.0	0.0145	0.0151	98.9
9	5.0	0.0145	0.0152	98.2
10	5.0	0.0147	0.0151	97.5
11	5.0	0.0141	0.0143	98.4
12	5.0	0.0143	0.0146	98.1
13	5.0	0.0147	0.0150	98.3
14	5.0	0.0146	0.0148	98.7
15	5.0	0.0147	0.0151	97.3
16	5.0	0.0144	0.0151	95.6
17	5.0	0.0152	0.0156	97.9
18	5.0	0.0145	0.0151	98.4
19	5.0	0.0143	0.0151	94.2
20	5.0	0.0154	0.0155	99.4
21	5.0	0.0148	0.0150	99.0
22	5.0	0.0140	0.0141	99.4
23	5.0	0.0137	0.0139	98.4
24	5.0	0.0138	0.0137	101.1
25	5.0	0.0131	0.0135	96.9
26	5.0	0.0133	0.0134	99.0
27	5.0	0.0130	0.0145	89.6
28	5.0	0.0143	0.0141	101.5
29	5.0	0.0144	0.0147	98.3
30	5.0	0.0147	0.0149	98.6
31	5.0	0.0145	0.0144	100.5
32	5.0	0.0150	0.0153	98.4
33	5.0	0.0150	0.0153	98.0
34	5.0	0.0150	0.0153	97.7
35	5.0	0.0139	0.0149	93.3
36	5.0	0.0136	0.0154	88.3
37	5.0	0.0155	0.0157	98.7
38	5.0	0.0145	0.0150	99.3
39	5.0	0.0143	0.0146	98.1
40	5.0	0.0150	0.0156	95.4
41	5.0	0.0145	0.0150	96.4
42	5.0	0.0145	0.0155	96.2
43	5.0	0.0150	0.0155	97.3
44	5.0	0.0148	0.0150	98.7
45	5.0	0.0120	0.0144	83.2
46	5.0	0.0133	0.0144	92.3
47	5.0	0.0129	0.0140	92.1
48	5.0	0.0138	0.0137	100.5

AVERAGE PERCENT ISOKINETICITY ACHIEVED

97.4

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS.(IN. HG.)	25.82	OR	655.81	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY(FPS)	42.96	OR	13.09	M/S
GAS FLOW(ACFM-DRY)	182570	OR	5170	ACM/M
GAS FLOW(SCFM-DRY)	146682	OR	4154	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	16.69
CO2	1.50	1.35
CO	0.00	0.00
N2	80.00	72.15
H2O		9.81

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	3.837E-05	OR	6.146E-01	GM/SCM
LBS/ACF	2.781E-05	OR	4.454E-01	GM/ACM
GRAINS/SCF	2.686E-01			
GRAINS/SCF (12% CO2)	2.149E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	1.450E+00			
GRAINS/ACF	1.947E-01			
LBS/HR	3.377E+02	OR	1.532E+02	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

ELKWOOD COAL PREP. PLANT, SPARWOOD, EC.

SEPT.10/84 17:38-19:01 PART#3

TRAVERSE DATA

TRAVERSE FT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F)	
						IN	OUT
					714.14		
1	2.5	101	0.470	1.420	715.83	59	58
2	2.5	104	0.500	1.500	717.53	60	58
3	2.5	101	0.520	1.570	719.26	63	58
4	2.5	100	0.590	1.790	721.08	66	59
5	2.5	102	0.570	1.720	722.89	68	59
6	2.5	94	0.660	2.020	724.85	71	60
7	2.5	102	0.650	1.970	726.83	74	60
8	2.5	98	0.680	2.150	728.88	76	61
9	2.5	100	0.730	2.180	730.97	79	62
10	2.5	99	0.680	2.160	733.00	81	63
11	2.5	96	0.650	2.070	734.95	83	64
12	2.5	100	0.600	1.900	736.95	83	64
13	2.5	98	0.620	1.980	739.00	85	65
14	2.5	101	0.620	1.970	741.04	91	66
15	2.5	98	0.620	1.980	743.05	89	67
16	2.5	98	0.650	2.080	745.12	90	68
17	2.5	99	0.630	2.020	746.97	92	69
18	2.5	98	0.630	2.040	749.01	93	70
19	2.5	98	0.640	2.060	751.06	94	71
20	2.5	101	0.590	1.900	753.04	95	72
21	2.5	101	0.620	2.000	755.06	96	73
22	2.5	103	0.540	1.730	756.97	97	73
23	2.5	96	0.520	1.690	758.83	97	74
23	2.5	100	0.520	1.690	760.70	98	75
23	2.5	95	0.510	1.670	762.55	98	76
23	2.5	100	0.520	1.690	764.45	98	77
22	2.5	99	0.590	1.920	766.46	99	77
21	2.5	90	0.600	1.990	768.49	100	79
20	2.5	93	0.620	2.050	770.51	101	79
19	2.5	100	0.610	1.990	772.54	101	79
18	2.5	85	0.620	2.080	774.61	102	80
17	2.5	93	0.690	2.280	776.77	101	80
16	2.5	79	0.690	2.340	778.95	102	80
15	0.6	78	0.690	2.340	779.46	102	80

AVERAGE		97		1.934		88	69
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AVL. TEMPERATURE	=	36.0	DEG. C
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TOTAL SAMPLE TIME	=	83.1	MIN.
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TOTAL SAMPLE VOLUME	=	55.236	SCF	OR	1.564	SCM
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SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.92	OR	658.37	MM HG
PILOT TUBE FACTOR		0.734			
METER CALIBRATION FACTOR		0.973			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH	(GM)	0.36780			
WT. OF PART. ON FILTER	(GM)	0.42740			
WATER COLLECTED IN IMPINGERS	(ML)	85.7			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	2.5	0.0128	0.0128	100.0
2	2.5	0.0129	0.0133	97.6
3	2.5	0.0131	0.0135	96.9
4	2.5	0.0137	0.0144	95.3
5	2.5	0.0136	0.0141	96.4
6	2.5	0.0145	0.0151	96.0
7	2.5	0.0148	0.0151	98.1
8	2.5	0.0152	0.0154	98.8
9	2.5	0.0155	0.0160	97.0
10	2.5	0.0150	0.0154	97.2
11	2.5	0.0143	0.0150	95.0
12	2.5	0.0147	0.0145	101.7
13	2.5	0.0150	0.0147	102.1
14	2.5	0.0149	0.0147	101.2
15	2.5	0.0146	0.0147	99.6
16	2.5	0.0150	0.0150	100.0
17	2.5	0.0134	0.0148	90.6
18	2.5	0.0148	0.0148	99.6
19	2.5	0.0148	0.0149	99.1
20	2.5	0.0143	0.0144	99.8
21	2.5	0.0146	0.0147	99.1
22	2.5	0.0138	0.0138	100.5
23	2.5	0.0133	0.0134	99.0
23	2.5	0.0134	0.0135	99.7
23	2.5	0.0132	0.0133	99.0
23	2.5	0.0136	0.0135	101.1
22	2.5	0.0144	0.0143	100.3
21	2.5	0.0143	0.0143	99.4
20	2.5	0.0143	0.0146	97.5
19	2.5	0.0145	0.0146	99.3
18	2.5	0.0144	0.0145	99.0
17	2.5	0.0152	0.0154	98.8
16	2.5	0.0150	0.0152	98.3
15	0.6	0.0146	0.0152	95.8

AVERAGE PERCENT ISOKINETICITY ACHIEVED

98.2

FLOW CONDITIONS DURING TEST -----

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS.(IN. HG.)	25.69	OR	657.70	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY(FPS)	42.42	OR	12.93	M/S
GAS FLOW(ACFM-DRY)	186052	OR	5269	ACM/M
GAS FLOW(SCFM-DRY)	155293	OR	4398	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	17.22
CO2	1.50	1.40
CO	0.00	0.00
N2	80.00	74.45
H2O		6.93

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE -----

LBS/SCF	3.174E-05	OR	5.084E-01	GM/SCM
LBS/ACF	2.466E-05	OR	3.949E-01	GM/ACM
GRAINS/SCF	2.222E-01			
GRAINS/SCF (12% CO2)	1.778E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	1.200E+00			
GRAINS/ACF	1.726E-01			
LBS/HR	2.956E+02	OR	1.342E+02	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

LEHIGH COAL PREP. PLANT, SPARKWOOD, LG.

SEPT. 11/64 14:05-17:30 PART 14

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H ₂ O)	ORIFICE PRESSURE (IN. H ₂ O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F)	
						IN.	OUT
					779.59		
2	4.0	97	0.490	1.540	782.31	58	56
2	4.0	93	0.480	1.520	785.11	61	57
3	4.0	97	0.550	1.730	788.10	66	57
4	4.0	104	0.540	1.680	791.07	74	58
5	4.0	107	0.560	1.740	794.07	77	60
6	4.0	104	0.610	1.910	797.25	81	61
7	4.0	102	0.640	2.010	800.48	85	63
8	4.0	100	0.650	2.070	803.75	89	65
9	4.0	102	0.650	2.070	807.04	91	67
10	4.0	100	0.660	2.120	810.33	77	70
11	4.0	99	0.640	2.060	813.55	83	71
12	4.0	100	0.620	2.000	816.77	88	72
13	4.0	103	0.610	1.960	819.99	92	73
14	4.0	103	0.640	2.060	823.25	94	75
15	4.0	101	0.670	2.170	826.60	95	76
16	4.0	100	0.660	2.200	830.03	96	75
17	4.0	100	0.650	2.110	833.33	96	76
18	4.0	101	0.660	2.140	836.71	98	76
19	4.0	99	0.640	2.080	840.00	99	77
20	4.0	104	0.600	1.940	843.17	100	78
21	4.0	101	0.590	1.920	846.40	99	78
22	4.0	106	0.500	1.610	849.35	98	79
23	4.0	103	0.470	1.520	852.26	97	78
23	4.0	102	0.470	1.520	855.12	97	78
23	4.0	103	0.460	1.490	857.98	88	77
23	4.0	104	0.460	1.480	860.85	91	77
24	4.0	102	0.550	1.780	863.88	94	78
21	4.0	106	0.600	1.930	867.06	96	78
20	4.0	103	0.630	2.040	870.25	96	78
19	4.0	102	0.650	2.110	873.53	96	79
18	4.0	102	0.660	2.150	877.03	98	78
17	4.0	100	0.660	2.210	880.47	100	78
16	4.0	97	0.700	2.300	883.93	101	79
15	4.0	99	0.690	2.250	887.33	103	79
14	4.0	104	0.630	2.040	890.67	102	80
13	4.0	102	0.680	2.220	894.08	104	81
12	4.0	101	0.550	1.800	897.24	104	81
11	4.0	100	0.560	1.840	900.35	104	82
10	4.0	101	0.540	1.770	903.45	104	83
9	4.0	102	0.660	2.160	906.76	104	83
8	4.0	102	0.660	2.160	910.13	104	84
7	4.0	102	0.630	2.060	913.45	104	83
6	4.0	102	0.610	2.000	916.60	104	83
5	4.0	102	0.570	1.670	919.76	102	83
4	4.0	104	0.530	1.730	922.82	102	83
3	4.0	102	0.520	1.700	925.72	102	83
2	4.0	105	0.460	1.560	928.70	101	82
1	4.0	104	0.460	1.500	931.52	101	82
AVERAGE		101		1.909		93	75

AVL. TEMPERATURE = 36.6 DEG. C

TOTAL SAMPLE TIME = 192.0 MIN.

TOTAL SAMPLE VOLUME = 126.232 SCF OR 3.575 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.75	OR	654.05	MM HG
PITOT TUBE FACTOR		0.734			
METER CALIBRATION FACTOR		0.973			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN FROBE WASH	(GM)	0.77450			
WT. OF PART. ON FILTER	(GM)	0.66850			
WATER COLLECTED IN IMPINGERS	(ML)	225.2			

ANALYSIS OF ISOKINETICITY

TRAVERSE Pt.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
2	4.0	0.0130	0.0131	98.9
2	4.0	0.0132	0.0129	102.0
3	4.0	0.0141	0.0139	101.7
4	4.0	0.0141	0.0139	101.9
5	4.0	0.0142	0.0141	100.7
6	4.0	0.0150	0.0147	101.6
7	4.0	0.0151	0.0151	100.0
8	4.0	0.0151	0.0151	99.8
9	4.0	0.0152	0.0152	100.2
10	4.0	0.0153	0.0153	100.3
11	4.0	0.0149	0.0150	98.9
12	4.0	0.0148	0.0148	100.0
13	4.0	0.0146	0.0147	100.6
14	4.0	0.0149	0.0151	99.1
15	4.0	0.0153	0.0154	99.2
16	4.0	0.0156	0.0155	100.7
17	4.0	0.0150	0.0151	99.0
18	4.0	0.0154	0.0153	100.6
19	4.0	0.0149	0.0150	99.0
20	4.0	0.0144	0.0146	98.6
21	4.0	0.0146	0.0144	101.3
22	4.0	0.0135	0.0134	100.9
23	4.0	0.0132	0.0129	102.5
23	4.0	0.0130	0.0129	100.7
23	4.0	0.0131	0.0128	102.6
23	4.0	0.0132	0.0128	102.9
22	4.0	0.0138	0.0140	98.5
21	4.0	0.0146	0.0146	99.6
20	4.0	0.0145	0.0149	97.3
19	4.0	0.0149	0.0152	98.3
18	4.0	0.0159	0.0153	104.0
17	4.0	0.0156	0.0155	100.4
16	4.0	0.0155	0.0157	99.1
15	4.0	0.0153	0.0156	98.1
14	4.0	0.0151	0.0150	101.2
13	4.0	0.0154	0.0155	99.1
12	4.0	0.0142	0.0139	101.9
11	4.0	0.0139	0.0141	99.2
10	4.0	0.0139	0.0138	100.7
9	4.0	0.0149	0.0153	97.4
8	4.0	0.0152	0.0153	99.1
7	4.0	0.0145	0.0149	100.0
6	4.0	0.0142	0.0147	96.4
5	4.0	0.0142	0.0142	100.2
4	4.0	0.0138	0.0137	100.7
3	4.0	0.0131	0.0136	96.2
2	4.0	0.0135	0.0131	103.3
1	4.0	0.0126	0.0126	99.8

AVERAGE PERCENT ISOKINETICITY ACHIEVED

99.9

FLOW CONDITIONS DURING TEST -----

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS. (IN. HG.)	25.73	OR	653.58	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY (FPS)	42.30	OR	12.89	M/S
GAS FLOW (ACFM-DRY)	183623	OR	5200	ACM/M
GAS FLOW (SCFM-DRY)	151044	OR	4278	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	17.04
CO2	1.50	1.38
CO	0.00	0.00
N2	80.00	73.69
H2O		7.89

SPECIFIC GRAVITY OF FLUE GAS (AIR=1.0) 0.97

PARTICULATE EMISSION RATE -----

LBS/SCF	2.521E-05	OR	4.037E-01	GM/SCM
LBS/ACF	1.910E-05	OR	3.059E-01	GM/ACM
GRAINS/SCF	1.764E-01			
GRAINS/SCF (12% CO2)	1.412E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	9.525E-01			
GRAINS/ACF	1.337E-01			
LBS/HR	2.284E+02	OR	1.036E+02	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

ELKWOOD COAL PREP. PLANT, SEARWOOD, EC.

SEPT. 12/64 11:50-15:59 PART 15

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP	VELOCITY PRESSURE	ORIFICE PRESSURE	GAS METER VOL	GAS METER TEMP	
		(DEC. F)	(IN. H ₂ O)	(IN. H ₂ O)	(CU. FT.)	IN	OUT
					938.97		
1	5.0	108	0.520	1.590	942.42	54	52
2	5.0	107	0.510	1.590	945.70	61	53
3	5.0	111	0.570	1.740	949.44	68	55
4	5.0	108	0.550	1.620	953.20	73	56
5	5.0	106	0.650	2.010	957.16	81	58
6	5.0	108	0.670	2.080	961.17	85	60
7	5.0	107	0.700	2.180	965.36	85	62
8	5.0	106	0.690	2.160	969.55	92	64
9	5.0	108	0.720	2.260	973.70	94	66
10	5.0	106	0.690	2.180	977.90	96	67
11	5.0	103	0.670	2.130	982.03	96	69
12	5.0	106	0.740	2.350	986.28	97	71
13	5.0	105	0.750	2.400	990.69	98	73
14	5.0	107	0.720	2.300	995.00	99	75
15	5.0	104	0.720	2.310	999.31	99	75
16	5.0	104	0.760	2.450	1003.72	100	76
17	5.0	107	0.750	2.410	1008.09	100	77
18	5.0	105	0.760	2.450	1012.53	100	78
19	5.0	102	0.760	2.470	1016.90	100	78
20	5.0	104	0.710	2.300	1021.27	101	79
21	5.0	107	0.640	2.060	1025.40	100	79
22	5.0	104	0.640	2.060	1029.45	100	80
23	5.0	104	0.660	1.950	1033.39	100	80
24	5.0	105	0.440	1.430	1037.25	101	81
25	5.0	104	0.440	1.430	1040.69	99	81
26	5.0	104	0.440	1.400	1044.05	99	81
27	5.0	103	0.580	1.880	1047.95	99	80
28	5.0	104	0.630	2.050	1052.00	101	81
29	5.0	102	0.680	2.220	1056.19	101	81
30	5.0	104	0.700	2.280	1060.50	102	82
31	5.0	104	0.700	2.280	1064.77	101	83
32	5.0	101	0.750	2.460	1069.19	101	83
33	5.0	102	0.780	2.550	1073.74	103	82
34	5.0	102	0.750	2.450	1078.22	103	82
35	5.0	104	0.740	2.420	1082.67	104	84
36	5.0	103	0.750	2.460	1087.16	104	84
37	5.0	104	0.750	2.450	1091.67	105	84
38	5.0	101	0.740	2.430	1096.10	105	84
39	5.0	101	0.760	2.500	1100.60	104	85
40	5.0	102	0.730	2.400	1105.05	106	85
41	5.0	101	0.740	2.440	1109.54	105	85
42	5.0	103	0.750	2.400	1113.99	106	85
43	5.0	102	0.760	2.300	1118.37	106	85
44	5.0	101	0.650	2.270	1122.70	104	85
45	5.0	98	0.650	2.140	1126.89	103	84
46	5.0	102	0.630	2.070	1131.02	103	84
47	5.0	102	0.550	1.930	1134.95	102	83
48	5.0	103	0.550	1.930	1138.59	100	83

AVERAGE	104	2.159	97	76
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OVER TEMPERATURE = 40.0 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 167.653 SCF OR 4.731 SCM

SAMPLING DATA

VAPOR PRESSURE (IN.HG.) 25.97 OR 655.64 MM HG
 PLOT TUBE FACTOR 0.734
 WATER CALIBRATION FACTOR 0.973
 NOZZLE DIAMETER (IN.) 0.150 OR 6.350 MM
 WT. OF PAPT. IN PAPER WASH (GM) 0.59370
 WT. OF PAPT. ON FILTER (GM) 0.74670
 WATER COLLECTED IN TAPINGERS (ML) 327.1

ANALYSIS OF ISOKINETICITY

AVERAGE F1.	SAMPLING TIME (MIN.) (CU. FT./SEC.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0136	0.0136	100.2
2	5.0	0.0126	0.0135	95.3
3	5.0	0.0146	0.0143	102.3
4	5.0	0.0145	0.0145	100.1
5	5.0	0.0152	0.0152	99.7
6	5.0	0.0153	0.0154	98.9
7	5.0	0.0155	0.0158	100.5
8	5.0	0.0157	0.0156	100.7
9	5.0	0.0156	0.0160	97.5
10	5.0	0.0157	0.0156	100.3
11	5.0	0.0153	0.0154	99.6
12	5.0	0.0158	0.0162	97.6
13	5.0	0.0163	0.0163	100.2
14	5.0	0.0160	0.0160	99.6
15	5.0	0.0159	0.0160	99.6
16	5.0	0.0162	0.0164	99.0
17	5.0	0.0162	0.0163	98.9
18	5.0	0.0163	0.0164	99.6
19	5.0	0.0160	0.0164	97.8
20	5.0	0.0160	0.0158	101.1
21	5.0	0.0152	0.0151	100.9
22	5.0	0.0146	0.0150	98.6
23	5.0	0.0144	0.0146	99.1
24	5.0	0.0141	0.0125	113.1
25	5.0	0.0126	0.0125	100.9
26	5.0	0.0125	0.0125	98.5
27	5.0	0.0143	0.0143	99.7
28	5.0	0.0140	0.0149	99.2
29	5.0	0.0153	0.0155	98.7
30	5.0	0.0157	0.0157	100.1
31	5.0	0.0156	0.0157	99.1
32	5.0	0.0161	0.0162	98.9
33	5.0	0.0166	0.0166	99.9
34	5.0	0.0163	0.0163	100.3
35	5.0	0.0162	0.0162	100.2
36	5.0	0.0163	0.0163	100.3
37	5.0	0.0164	0.0163	100.8
38	5.0	0.0160	0.0161	99.4
39	5.0	0.0163	0.0163	99.6
40	5.0	0.0161	0.0160	100.4
41	5.0	0.0162	0.0161	100.6
42	5.0	0.0161	0.0160	100.5
43	5.0	0.0158	0.0157	100.9
44	5.0	0.0157	0.0156	100.5
45	5.0	0.0151	0.0151	100.1
46	5.0	0.0150	0.0149	100.6
47	5.0	0.0143	0.0144	99.0
48	5.0	0.0147	0.0144	102.1

AVERAGE PERCENT ISOKINETICITY ACHIEVED

99.8

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS.(IN. HG.)	25.95	OR	659.08	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY(FPS)	44.98	OR	13.71	M/S
GAS FLOW(ACFM-DRY)	193755	OR	5487	ACM/M
GAS FLOW(SCFM-DRY)	159996	OR	4531	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	16.91
CO2	1.50	1.37
CO	0.00	0.00
N2	80.00	73.13
H2O		8.59

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	1.769E-05	OR	2.834E-01	GM/SCM
LBS/ACF	1.335E-05	OR	2.139E-01	GM/ACM
GRAINS/SCF	1.238E-01			
GRAINS/SCF (12% CO2)	9.908E-01			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	6.686E-01			
GRAINS/ACF	5.348E-02			
LBS/HR	1.698E+02	OR	7.704E+01	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

RUN NO. 6

PAGE 1

ELKVIEW COAL PREP. PLANT, SPARWOOD, EC.

SEPT.8/84 10:18-14:40 ORG.#1A DF-1A (1ST HALF)

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F)	
						IN	OUT
					137.65		
1	4.0	104	0.250	0.780	139.78	56	50
2	4.0	104	0.400	1.250	142.34	60	51
3	4.0	112	0.470	1.450	145.11	68	52
4	4.0	104	0.520	1.630	148.07	75	53
5	4.0	110	0.610	1.900	151.24	83	54
6	4.0	110	0.550	1.720	154.32	85	56
7	4.0	110	0.700	2.200	157.74	93	58
8	4.0	114	0.700	2.200	161.17	97	60
9	4.0	114	0.630	1.980	164.47	98	63
10	4.0	113	0.630	1.990	167.75	101	64
11	4.0	118	0.680	2.140	171.18	104	67
12	4.0	118	0.710	2.240	174.61	105	69
13	4.0	119	0.700	2.220	178.11	107	71
14	4.0	112	0.790	2.540	181.74	108	73
15	4.0	107	0.800	2.600	185.42	108	75
16	4.0	109	0.900	2.930	188.95	110	77
17	4.0	110	0.820	2.680	192.56	111	79
18	4.0	105	0.900	2.960	196.16	110	80
19	4.0	105	0.920	3.040	199.81	111	81
20	4.0	103	0.940	3.320	203.38	112	82
21	4.0	104	0.910	3.020	206.96	113	83
22	4.0	103	0.910	3.030	210.56	115	84
23	4.0	105	0.840	2.800	214.14	115	85
24	4.0	103	0.830	2.780	217.71	115	86
AVERAGE		109		2.299		98	69

AVE. TEMPERATURE = 42.5 DEG. C

TOTAL SAMPLE TIME = 96.0 MIN.

TOTAL SAMPLE VOLUME = 66.938 SCF OR 1.896 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.89	OR	657.61	MM HG
PILOT TUBE FACTOR		0.774			
METER CALIBRATION FACTOR		0.971			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH	(GM)	0.00000			
WT. OF PART. ON FILTER	(GM)	0.00000			
WATER COLLECTED IN IMPINGERS	(ML)	156.4			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	4.0	0.0106	0.0100	106.3
2	4.0	0.0127	0.0126	100.5
3	4.0	0.0138	0.0137	100.2
4	4.0	0.0144	0.0144	100.4
5	4.0	0.0155	0.0156	99.0
6	4.0	0.0150	0.0148	100.9
7	4.0	0.0165	0.0167	98.5
8	4.0	0.0166	0.0168	98.6
9	4.0	0.0159	0.0159	99.6
10	4.0	0.0157	0.0159	98.5
11	4.0	0.0165	0.0166	99.1
12	4.0	0.0164	0.0170	96.7
13	4.0	0.0167	0.0169	99.1
14	4.0	0.0171	0.0178	96.0
15	4.0	0.0172	0.0179	96.1
16	4.0	0.0165	0.0190	86.9
17	4.0	0.0166	0.0181	92.8
18	4.0	0.0166	0.0189	88.0
19	4.0	0.0169	0.0191	88.1
20	4.0	0.0164	0.0193	85.1
21	4.0	0.0164	0.0190	86.5
22	4.0	0.0165	0.0190	86.7
23	4.0	0.0164	0.0183	89.8
24	4.0	0.0163	0.0181	89.9

AVERAGE PERCENT ISOKINETICITY ACHIEVED

94.8

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS. (IN. HG.)	25.86	OR	656.91	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY (FPS)	48.88	OR	14.90	M/S
GAS FLOW (ACFM-DRY)	207131	OR	5866	ACM/M
GAS FLOW (SCFM-DRY)	169105	OR	4789	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	16.63
CO2	1.50	1.35
CO	0.00	0.00
N2	80.00	71.93
H2O		10.08

SPECIFIC GRAVITY OF FLUE GAS (AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

RUN NO. 7

PAGE 1

ELKVIEW COAL PREP. PLANT SPARWOOD, BC.

SEPT.8/84 10:18-1440 ORG.#1B DF-1B (2ND HALF)

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F.)	
						IN	OUT
					217.71		
24	4.0	102	0.610	0.650	219.74	101	86
23	4.0	107	0.710	0.750	221.88	103	87
22	4.0	104	0.750	0.790	224.09	105	86
21	4.0	109	0.830	0.870	226.40	109	87
20	4.0	103	0.930	0.990	228.84	110	87
19	4.0	107	0.890	0.940	231.23	112	87
18	4.0	104	0.930	0.980	233.66	112	87
17	4.0	105	0.900	0.950	236.08	113	87
16	4.0	106	0.850	0.900	238.41	114	88
15	4.0	104	0.840	0.890	240.76	114	88
14	4.0	106	0.750	0.790	242.97	114	89
13	4.0	112	0.690	0.720	245.08	113	89
12	4.0	117	0.650	0.680	247.15	113	89
11	4.0	115	0.600	0.630	249.15	112	90
10	4.0	116	0.580	0.610	251.12	112	90
9	4.0	115	0.630	0.660	253.15	111	90
8	4.0	112	0.620	0.650	255.17	112	90
7	4.0	112	0.600	0.630	257.18	110	90
6	4.0	112	0.570	0.600	259.14	110	91
5	4.0	112	0.500	0.520	260.98	112	90
4	4.0	112	0.430	0.450	262.71	111	90
3	4.0	116	0.350	0.360	264.26	110	90
2	4.0	111	0.280	0.290	265.68	111	91
1	4.0	109	0.260	0.270	267.05	108	91

AVERAGE 109 0.688 110 88

AVE. TEMPERATURE = 42.8 DEG. C

TOTAL SAMPLE TIME = 96.0 MIN.

TOTAL SAMPLE VOLUME = 39.889 SCF OR 1.130 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.89	OR	657.61	MM HG
PILOT TUBE FACTOR		0.774			
METER CALIBRATION FACTOR		0.971			
NOZZLE DIAMETER	(IN.)	0.188	OR	4.763	MM
WT. OF PART. IN PROBE WASH	(GM)	0.00000			
WT. OF PART. ON FILTER	(GM)	0.00000			
WATER COLLECTED IN IMPINGERS	(ML)	93.6			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
24	4.0	0.0093	0.0087	106.4
23	4.0	0.0099	0.0095	104.3
22	4.0	0.0101	0.0097	104.5
21	4.0	0.0106	0.0103	103.8
20	4.0	0.0111	0.0108	103.0
19	4.0	0.0109	0.0106	103.3
18	4.0	0.0111	0.0108	102.5
17	4.0	0.0110	0.0106	103.7
16	4.0	0.0106	0.0103	102.6
15	4.0	0.0107	0.0103	104.0
14	4.0	0.0101	0.0097	103.5
13	4.0	0.0097	0.0094	103.7
12	4.0	0.0096	0.0091	105.2
11	4.0	0.0093	0.0088	105.6
10	4.0	0.0091	0.0086	105.9
9	4.0	0.0094	0.0090	104.7
8	4.0	0.0093	0.0089	104.7
7	4.0	0.0093	0.0087	106.1
6	4.0	0.0090	0.0085	106.0
5	4.0	0.0085	0.0080	106.1
4	4.0	0.0080	0.0074	107.7
3	4.0	0.0072	0.0067	107.4
2	4.0	0.0065	0.0060	109.3
1	4.0	0.0063	0.0057	109.5

AVERAGE PERCENT ISOKINETICITY ACHIEVED

104.7

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS.(IN. HG.)	25.86	OR	656.91	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY(FPS)	46.77	OR	14.26	M/S
GAS FLOW(ACFM-DRY)	198082	OR	5610	ACM/M
GAS FLOW(SCFM-DRY)	161575	OR	4576	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	16.63
CO2	1.50	1.35
CO	0.00	0.00
N2	80.00	71.90
H2O		10.12

SPECIFIC GRAVITY OF FLUE GAS(AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

EDNAVIEW COAL FIELD, PLANT SPARKWOOD, EC.

SEP1.9/64 12:35-17:15 ORG.42

DF-2

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEC. F)	VELOCITY PRESSURE (IN. H ₂ O)	ORIFICE PRESSURE (IN. H ₂ O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEC. F)	
						IN	OUT
1	5.0	116	0.370	0.350	267.24		
2	5.0	117	0.480	0.460	269.08	54	53
3	5.0	115	0.520	0.500	271.14	59	53
4	5.0	113	0.600	0.580	273.29	64	54
5	5.0	115	0.620	0.600	275.63	69	55
6	5.0	114	0.650	0.630	277.96	74	57
7	5.0	114	0.650	0.630	280.36	79	58
8	5.0	118	0.570	0.550	282.75	60	60
9	5.0	121	0.560	0.540	285.02	64	62
10	5.0	118	0.650	0.630	287.27	88	64
11	5.0	121	0.610	0.600	289.69	91	66
12	5.0	121	0.630	0.620	292.05	93	69
13	5.0	122	0.660	0.650	292.05	95	71
14	5.0	108	0.660	0.650	294.45	98	72
15	5.0	111	0.780	0.790	296.93	100	74
16	5.0	113	0.620	0.630	299.65	102	76
17	5.0	113	0.790	0.800	302.45	103	78
18	5.0	115	0.830	0.840	305.20	105	80
19	5.0	116	0.800	0.810	308.01	106	82
20	5.0	110	0.770	0.780	310.78	108	83
21	5.0	105	0.770	0.780	313.52	83	80
22	5.0	110	0.730	0.750	316.23	86	80
23	5.0	107	0.570	0.580	318.88	91	80
24	5.0	107	0.510	0.520	321.25	93	80
25	5.0	108	0.500	0.510	323.51	96	80
26	5.0	110	0.490	0.500	325.74	98	80
27	5.0	107	0.480	0.490	327.95	98	80
28	5.0	107	0.570	0.580	330.14	100	81
29	5.0	107	0.650	0.670	332.52	101	82
30	5.0	110	0.710	0.720	335.05	101	82
31	5.0	105	0.710	0.720	337.68	104	83
32	5.0	108	0.750	0.760	340.34	103	84
33	5.0	107	0.740	0.760	343.10	103	84
34	5.0	106	0.740	0.760	345.80	103	84
35	5.0	106	0.610	0.630	348.60	103	84
36	5.0	106	0.810	0.830	351.43	104	83
37	5.0	108	0.800	0.820	354.35	104	84
38	5.0	110	0.750	0.770	356.93	105	85
39	5.0	108	0.710	0.720	359.57	106	84
40	5.0	108	0.680	0.700	362.18	106	86
41	5.0	113	0.550	0.560	364.52	106	86
42	5.0	112	0.650	0.670	367.08	105	86
43	5.0	111	0.560	0.590	369.50	105	86
44	5.0	117	0.560	0.570	371.87	105	86
45	5.0	112	0.610	0.620	374.33	105	86
46	5.0	113	0.610	0.620	376.78	105	86
47	5.0	114	0.570	0.580	379.18	104	87
48	5.0	116	0.470	0.490	381.39	105	86
49	5.0	112	0.440	0.450	383.53	106	87
50	5.0	113	0.360	0.370	385.48	105	87

AVERAGE	112	0.640	55	77
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OVL. TEMPERATURE = 44.4 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 97.771 SCF OR 2.769 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.65	OR	656.55	MM HG
PILOT TUBE FACTOR		0.774			
METER CALIBRATION FACTOR		0.971			
NOZZLE DIAMETER	(IN.)	0.188	OR	4.763	MM
WT. OF PART. IN PROBE WASH	(GM)	0.00000			
WT. OF PART. ON FILTER	(GM)	0.00000			
WATER COLLECTED IN IMPINGERS	(ML)	255.2			

ANALYSIS OF ISOKINETICITY

INVERSE FT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0076	0.0069	109.4
2	5.0	0.0064	0.0079	106.6
3	5.0	0.0067	0.0082	106.3
4	5.0	0.0094	0.0088	107.0
5	5.0	0.0093	0.0089	104.3
6	5.0	0.0095	0.0091	104.2
7	5.0	0.0096	0.0091	105.5
8	5.0	0.0090	0.0086	104.7
9	5.0	0.0089	0.0085	104.4
10	5.0	0.0095	0.0092	103.5
11	5.0	0.0093	0.0089	103.9
12	5.0	0.0094	0.0090	103.6
13	5.0	0.0097	0.0093	104.2
14	5.0	0.0103	0.0100	103.7
15	5.0	0.0106	0.0102	104.0
16	5.0	0.0109	0.0101	103.9
17	5.0	0.0107	0.0103	103.2
18	5.0	0.0105	0.0101	103.6
19	5.0	0.0104	0.0100	104.2
20	5.0	0.0104	0.0099	105.2
21	5.0	0.0101	0.0096	104.9
22	5.0	0.0090	0.0085	106.1
23	5.0	0.0086	0.0080	106.4
24	5.0	0.0084	0.0080	105.9
25	5.0	0.0084	0.0079	106.0
26	5.0	0.0083	0.0078	105.8
27	5.0	0.0090	0.0085	105.3
28	5.0	0.0095	0.0091	104.6
29	5.0	0.0099	0.0095	104.4
30	5.0	0.0099	0.0097	101.9
31	5.0	0.0103	0.0097	106.7
32	5.0	0.0101	0.0097	104.3
33	5.0	0.0109	0.0101	103.3
34	5.0	0.0106	0.0101	104.4
35	5.0	0.0109	0.0101	108.5
36	5.0	0.0097	0.0098	99.0
37	5.0	0.0099	0.0095	103.9
38	5.0	0.0097	0.0093	104.8
39	5.0	0.0088	0.0084	104.9
40	5.0	0.0096	0.0091	105.6
41	5.0	0.0091	0.0086	105.5
42	5.0	0.0090	0.0085	105.7
43	5.0	0.0093	0.0088	104.7
44	5.0	0.0092	0.0088	104.4
45	5.0	0.0091	0.0086	105.6
46	5.0	0.0084	0.0078	107.7
47	5.0	0.0080	0.0075	107.0
48	5.0	0.0073	0.0068	107.7

AVERAGE PERCENT ISOKINETICITY ACHIEVED

104.6

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS. (IN. HG.)	25.82	OR	655.94	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY (FPS)	46.73	OR	14.24	M/S
GAS FLOW (ACFM-DRY)	195696	OR	5542	ACM/M
GAS FLOW (SCFM-DRY)	158594	OR	4491	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	16.44
CO2	1.50	1.33
CO	0.00	0.00
N2	80.00	71.09
H2O		11.13

SPECIFIC GRAVITY OF FLUE GAS (AIR=1.0) 0.96

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

RUN NO. 9

PAGE 1

ELKVIEW COAL PREP. PLANT, SPARWOOD, EC.

SEPT.10/84 17:38-19:01 ORG.#3

PAW/PCB-1

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F.)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F.) IN OUT	
					386.22		
1	2.5	100	0.340	1.070	387.77	59	58
2	2.5	90	0.360	1.150	389.34	62	58
3	2.5	98	0.470	1.470	391.11	64	58
4	2.5	92	0.510	1.620	392.98	69	59
5	2.5	100	0.580	1.820	394.96	74	59
6	2.5	86	0.600	1.940	397.02	78	60
7	2.5	100	0.600	1.940	399.04	84	61
8	2.5	98	0.600	1.980	401.13	87	62
9	2.5	98	0.630	2.070	403.24	89	63
10	2.5	98	0.670	2.220	405.44	93	64
11	2.5	95	0.720	2.390	407.73	96	65
12	2.5	98	0.610	2.000	409.85	99	67
13	2.5	92	0.760	2.520	412.20	100	68
14	2.5	92	0.750	2.500	414.54	103	69
15	2.5	90	0.800	2.670	416.96	105	71
16	2.5	89	0.860	2.900	419.50	105	72
17	2.5	92	0.800	2.670	421.97	109	73
18	2.5	95	0.900	3.050	424.54	109	74
19	2.5	92	0.910	3.080	427.14	110	76
20	2.5	95	0.850	2.890	429.70	112	78
21	2.5	95	0.850	2.890	432.23	113	79
22	2.5	98	0.780	2.660	434.70	114	81
23	2.5	92	0.730	2.520	437.08	115	82
24	2.5	93	0.630	2.170	439.31	116	83
24	2.5	87	0.570	1.970	441.44	117	83
23	2.5	88	0.600	2.070	443.59	116	84
22	2.5	92	0.730	2.520	445.97	116	85
21	2.5	87	0.850	2.930	448.55	118	86
20	2.5	88	0.930	3.240	451.25	119	87
19	2.5	94	0.930	3.270	453.95	121	88
18	2.5	89	0.970	3.410	456.72	121	88
17	2.5	92	0.970	3.410	459.53	122	89
16	2.5	75	0.980	3.440	462.29	123	90

AVERAGE 92 2.431 101 73

AVL. TEMPERATURE = 33.6 DEG. C

TOTAL SAMPLE TIME = 62.5 MIN.

TOTAL SAMPLE VOLUME = 63.262 SCF OF 1.792 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.92	OR	658.37	MM HG
PITOT TUBE FACTOR		0.774			
METER CALIBRATION FACTOR		0.971			
NOZZLE DIAMETER	(IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH	(GM)	0.00000			
WT. OF PART. ON FILTER	(GM)	0.00000			
WATER COLLECTED IN IMPINGERS	(ML)	83.9			

ANALYSIS OF ISOKINETICITY

TRAVERSE FT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	2.5	0.0116	0.0115	100.9
2	2.5	0.0115	0.0117	98.2
3	2.5	0.0131	0.0135	97.5
4	2.5	0.0136	0.0139	97.8
5	2.5	0.0146	0.0150	97.4
6	2.5	0.0147	0.0150	97.9
7	2.5	0.0147	0.0152	96.6
8	2.5	0.0151	0.0152	99.4
9	2.5	0.0152	0.0156	97.7
10	2.5	0.0158	0.0161	98.4
11	2.5	0.0163	0.0166	98.2
12	2.5	0.0151	0.0153	98.5
13	2.5	0.0166	0.0170	97.2
14	2.5	0.0164	0.0169	97.1
15	2.5	0.0169	0.0174	96.7
16	2.5	0.0177	0.0181	97.8
17	2.5	0.0172	0.0175	98.4
18	2.5	0.0180	0.0186	96.8
19	2.5	0.0180	0.0186	96.8
20	2.5	0.0176	0.0181	98.5
21	2.5	0.0175	0.0181	97.2
22	2.5	0.0172	0.0173	99.0
23	2.5	0.0163	0.0167	97.8
24	2.5	0.0153	0.0155	98.5
24	2.5	0.0144	0.0147	98.2
23	2.5	0.0146	0.0151	96.6
22	2.5	0.0163	0.0167	97.5
21	2.5	0.0175	0.0179	97.4
20	2.5	0.0183	0.0188	97.4
19	2.5	0.0184	0.0189	97.7
18	2.5	0.0187	0.0192	97.7
17	2.5	0.0191	0.0192	99.2
16	2.5	0.0181	0.0190	95.3

AVERAGE PERCENT ISOKINETICITY ACHIEVED

97.5

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS. (IN. HG.)	25.89	OR	657.70	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY (FPS)	48.21	OR	14.69	M/S
GAS FLOW (ACFM-DRY)	213596	OR	6049	ACM/M
GAS FLOW (SCFM-DRY)	179680	OR	5089	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	17.39
CO2	1.50	1.41
CO	0.00	0.00
N2	80.00	75.21
H2O		5.98

SPECIFIC GRAVITY OF FLUE GAS (AIR=1.0) 0.98

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

LLAVIEW COAL PREP. PLANT, SPARKWOOD, EC.

SEP11/64 14:05-17:38 CRC.84

PAH/PCB-2

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F)	
						IN	OUT
1	5.0	90	0.430	1.370	462.57		
2	3.0	92	0.480	1.520	466.42	60	56
3	4.0	96	0.620	1.950	468.35	65	56
4	4.0	100	0.610	1.910	471.89	72	57
5	4.0	103	0.630	1.970	475.05	77	58
6	4.0	101	0.660	2.080	478.34	84	59
7	4.0	100	0.680	2.160	481.62	86	61
8	4.0	96	0.680	2.180	484.69	92	64
9	4.0	99	0.650	2.080	488.14	95	66
10	4.0	101	0.700	2.250	491.36	95	68
11	4.0	98	0.740	2.380	494.94	87	73
12	4.0	98	0.740	2.380	498.58	94	73
13	4.0	97	0.720	2.400	502.24	99	74
14	4.0	94	0.780	2.330	505.89	104	76
15	4.0	92	0.940	2.560	509.70	110	77
16	4.0	93	0.930	3.110	513.47	111	79
17	4.0	94	0.930	3.080	517.27	110	81
18	4.0	94	0.920	3.080	521.05	113	82
19	4.0	91	0.790	3.020	524.83	113	83
20	4.0	94	0.850	2.640	528.58	115	84
21	4.0	93	0.800	2.840	532.33	117	90
22	4.0	95	0.650	2.680	536.05	116	87
23	4.0	93	0.560	2.170	539.66	117	86
24	4.0	93	0.560	1.820	542.97	118	89
25	4.0	94	0.540	1.890	546.30	119	90
26	4.0	94	0.540	1.820	549.58	109	90
27	4.0	95	0.680	1.820	552.85	111	89
28	4.0	94	0.760	2.280	556.47	113	89
29	4.0	90	0.640	2.550	560.11	114	69
30	4.0	92	0.920	2.810	563.74	112	91
31	4.0	92	0.940	3.110	567.35	112	91
32	4.0	93	0.960	3.170	570.98	113	90
33	4.0	92	0.990	3.310	574.63	113	91
34	4.0	94	0.940	3.340	578.18	114	90
35	4.0	97	0.880	3.170	581.77	115	91
36	4.0	95	0.840	2.970	585.33	115	92
37	4.0	97	0.780	2.840	588.90	118	92
38	4.0	100	0.740	2.630	592.42	118	93
39	4.0	103	0.710	2.500	595.94	118	94
40	4.0	103	0.690	2.360	599.41	117	93
41	4.0	100	0.550	2.300	602.85	118	94
42	4.0	101	0.500	1.830	606.16	117	94
43	4.0	100	0.550	1.660	609.31	119	94
44	4.0	101	0.600	1.620	612.60	120	95
45	4.0	100	0.600	2.000	616.00	117	95
46	4.0	100	0.600	2.000	619.38	118	96
47	4.0	98	0.550	1.830	622.70	117	95
48	4.0	101	0.450	1.500	625.71	117	95
49	4.0	100	0.450	1.500	628.72	116	95

AVERAGE	96	2.341	107	83
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AVE. TEMPERATURE = 35.6 DEG. C

TOTAL SAMPLE TIME = 192.0 MIN.

TOTAL SAMPLE VOLUME = 134.551 SCF OR 3.822 SCM

SAMPLING DATA

BAROMETRIC PRESSURE (IN.HG.)	25.75	OR	654.05	MM HG
PISTON TUBE FACTOR	0.774			
NOZZLE CALIBRATION FACTOR	0.971			
NOZZLE DIAMETER (IN.)	0.250	OR	6.350	MM
WT. OF PART. IN PROBE WASH (GM)	0.00000			
WT. OF PART. ON FILTER (GM)	0.00000			
WATER COLLECTED IN IMPINGERS (ML)	206.7			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0126	0.0128	99.6
2	3.0	0.0132	0.0136	96.7
3	4.0	0.0155	0.0155	99.8
4	4.0	0.0147	0.0154	95.0
5	4.0	0.0152	0.0157	96.6
6	4.0	0.0151	0.0161	93.6
7	4.0	0.0145	0.0163	91.3
8	4.0	0.0146	0.0162	90.0
9	4.0	0.0145	0.0159	91.3
10	4.0	0.0163	0.0166	98.3
11	4.0	0.0164	0.0170	96.4
12	4.0	0.0164	0.0170	96.4
13	4.0	0.0162	0.0167	96.7
14	4.0	0.0167	0.0174	96.2
15	4.0	0.0165	0.0190	86.4
16	4.0	0.0166	0.0185	87.6
17	4.0	0.0165	0.0190	86.9
18	4.0	0.0165	0.0189	87.3
19	4.0	0.0162	0.0174	92.6
20	4.0	0.0162	0.0181	89.1
21	4.0	0.0161	0.0176	91.3
22	4.0	0.0156	0.0159	98.2
23	4.0	0.0142	0.0147	96.6
24	4.0	0.0143	0.0147	97.0
25	4.0	0.0142	0.0145	98.2
26	4.0	0.0141	0.0145	97.6
27	4.0	0.0157	0.0162	96.6
28	4.0	0.0157	0.0171	91.8
29	4.0	0.0156	0.0180	86.6
30	4.0	0.0157	0.0188	83.6
31	4.0	0.0155	0.0190	81.4
32	4.0	0.0156	0.0195	81.1
33	4.0	0.0153	0.0195	78.4
34	4.0	0.0155	0.0191	81.3
35	4.0	0.0154	0.0185	83.4
36	4.0	0.0154	0.0180	85.2
37	4.0	0.0152	0.0174	87.2
38	4.0	0.0153	0.0170	89.7
39	4.0	0.0151	0.0167	90.6
40	4.0	0.0150	0.0165	90.9
41	4.0	0.0143	0.0147	97.7
42	4.0	0.0136	0.0140	97.4
43	4.0	0.0142	0.0147	96.6
44	4.0	0.0147	0.0153	96.1
45	4.0	0.0146	0.0153	95.3
46	4.0	0.0143	0.0146	97.7
47	4.0	0.0130	0.0133	98.1
48	4.0	0.0130	0.0133	98.0

AVERAGE PERCENT ISOKINETICITY ACHIEVED

92.2

FLOW CONDITIONS DURING TEST

STACK AREA F12	78.54	OR	7.30	SQR M
ABS. STACK PRESS. (IN. HG.)	25.72	OR	653.25	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY (FPS)	48.31	OR	14.72	M/S
GAS FLOW (ACFM-DRY)	212048	OR	6005	ACM/M
GAS FLOW (SCFM-DRY)	176004	OR	4984	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O2	18.50	17.23
CO2	1.50	1.40
CO	0.00	0.00
N2	80.00	74.52
H2O		6.65

SPECIFIC GRAVITY OF FLUE GAS (AIR=1.0) 0.97

PARTICULATE EMISSION RATE

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO2)	0.000E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY

LEAVIE COAL PREP. PLANT, SPARWOOD, EC.

SEP. 12/84 11:56-16:00 URG.#5

DF-3

TRAVERSE DATA

TRAVERSE PT.	SAMPLE TIME (MIN)	STACK GAS TEMP (DEG. F)	VELOCITY PRESSURE (IN. H2O)	ORIFICE PRESSURE (IN. H2O)	GAS METER VOL (CU. FT.)	GAS METER TEMP (DEG. F)	IN	OUT
					643.74			
1	5.0	102	0.380	1.220	646.02	56	54	
2	5.0	101	0.450	0.470	648.01	62	55	
3	5.0	103	0.530	0.540	650.24	67	56	
4	5.0	103	0.610	0.620	652.63	73	57	
5	5.0	103	0.660	0.670	655.10	78	59	
6	5.0	107	0.670	0.680	657.57	81	61	
7	5.0	105	0.670	0.680	660.08	86	63	
8	5.0	106	0.660	0.680	662.55	89	66	
9	5.0	108	0.660	0.680	665.08	91	67	
10	5.0	108	0.700	0.720	667.70	92	69	
11	5.0	109	0.750	0.770	670.34	95	72	
12	5.0	109	0.740	0.780	673.02	98	73	
13	5.0	105	0.760	0.800	675.75	100	75	
14	5.0	100	0.760	0.800	678.48	100	77	
15	5.0	101	0.830	0.880	681.35	102	78	
16	5.0	100	0.910	0.980	684.34	104	79	
17	5.0	101	0.880	0.940	687.31	105	81	
18	5.0	100	0.900	0.960	690.30	104	82	
19	5.0	96	0.890	0.970	693.31	105	83	
20	5.0	96	0.890	0.970	696.30	106	84	
21	5.0	98	0.870	0.940	699.27	107	86	
22	5.0	98	0.810	0.880	702.15	106	86	
23	5.0	95	0.740	0.810	704.91	105	86	
24	5.0	95	0.620	0.680	707.47	105	85	
25	5.0	95	0.620	0.680	710.04	104	86	
26	5.0	95	0.620	0.680	712.61	105	87	
27	5.0	95	0.770	0.840	715.44	107	88	
28	5.0	96	0.850	0.930	718.43	109	88	
29	5.0	94	0.860	0.940	721.39	110	89	
30	5.0	94	0.870	0.950	724.39	110	88	
31	5.0	96	0.880	0.970	727.41	111	89	
32	5.0	95	0.890	0.980	730.47	111	90	
33	5.0	94	0.930	1.020	733.56	112	90	
34	5.0	95	0.920	1.010	736.67	112	90	
35	5.0	94	0.920	1.010	739.77	113	91	
36	5.0	95	0.860	0.970	742.82	112	91	
37	5.0	95	0.760	0.860	745.69	112	92	
38	5.0	100	0.740	0.810	748.49	111	91	
39	5.0	102	0.740	0.810	751.31	112	90	
40	5.0	103	0.700	0.760	754.03	111	92	
41	5.0	104	0.680	0.740	756.72	110	92	
42	5.0	103	0.670	0.730	759.40	109	91	
43	5.0	103	0.680	0.740	762.08	110	91	
44	5.0	101	0.690	0.750	764.77	110	90	
45	5.0	100	0.620	0.680	767.35	110	91	
46	5.0	102	0.540	0.590	769.77	108	90	
47	5.0	100	0.400	0.440	771.90	108	91	
48	5.0	100	0.350	0.430	774.00	106	90	
AVERAGE		100		0.759		101	81	

AVE. TEMPERATURE = 37.8 DEG. C

TOTAL SAMPLE TIME = 240.0 MIN.

TOTAL SAMPLE VOLUME = 107.271 SCF OR 3.036 SCM

SAMPLING DATA

BAROMETRIC PRESSURE	(IN.HG.)	25.97	OR	659.64	MM HG
PITOT TUBE FACTOR		0.774			
METER CALIBRATION FACTOR		0.971			
NOZZLE DIAMETER	(IN.)	0.186	OR	4.763	MM
WT. OF PAK. IN PROBE WASH	(GM)	0.00000			
WT. OF PAK. ON FILTER	(GM)	0.00000			
WATER COLLECTED IN IMPINGERS	(ML)	185.4			

ANALYSIS OF ISOKINETICITY

TRAVERSE PT.	SAMPLING TIME (MIN.)	ACTUAL SAMPLING RATE (CU. FT./SEC.)	ISOKINETIC SAMPLING RATE (CU. FT./SEC.)	PERCENT ISOKINETICITY ACHIEVED
1	5.0	0.0088	0.0069	127.7
2	5.0	0.0076	0.0074	101.6
3	5.0	0.0085	0.0061	104.5
4	5.0	0.0090	0.0067	103.7
5	5.0	0.0093	0.0090	102.4
6	5.0	0.0093	0.0091	101.5
7	5.0	0.0093	0.0091	102.3
8	5.0	0.0093	0.0091	102.6
9	5.0	0.0092	0.0091	101.7
10	5.0	0.0097	0.0093	103.6
11	5.0	0.0097	0.0097	100.4
12	5.0	0.0098	0.0096	102.2
13	5.0	0.0099	0.0097	102.0
14	5.0	0.0098	0.0097	101.4
15	5.0	0.0103	0.0101	101.8
16	5.0	0.0107	0.0106	101.0
17	5.0	0.0106	0.0104	101.6
18	5.0	0.0107	0.0105	101.3
19	5.0	0.0106	0.0104	102.0
20	5.0	0.0105	0.0104	101.1
21	5.0	0.0105	0.0103	101.5
22	5.0	0.0102	0.0100	102.0
23	5.0	0.0097	0.0095	102.1
24	5.0	0.0090	0.0087	103.5
25	5.0	0.0090	0.0087	103.9
26	5.0	0.0090	0.0087	103.7
27	5.0	0.0099	0.0097	102.3
28	5.0	0.0105	0.0102	102.6
29	5.0	0.0103	0.0102	100.6
30	5.0	0.0105	0.0103	102.0
31	5.0	0.0106	0.0104	101.6
32	5.0	0.0107	0.0104	102.4
33	5.0	0.0108	0.0106	101.6
34	5.0	0.0106	0.0106	101.6
35	5.0	0.0106	0.0106	101.6
36	5.0	0.0106	0.0104	102.4
37	5.0	0.0100	0.0096	102.6
38	5.0	0.0096	0.0095	103.0
39	5.0	0.0099	0.0096	104.0
40	5.0	0.0096	0.0093	103.1
41	5.0	0.0095	0.0092	103.6
42	5.0	0.0095	0.0091	104.1
43	5.0	0.0095	0.0092	103.2
44	5.0	0.0095	0.0092	102.8
45	5.0	0.0091	0.0087	103.6
46	5.0	0.0086	0.0082	104.7
47	5.0	0.0075	0.0070	106.8
48	5.0	0.0074	0.0069	106.9

AVERAGE PERCENT ISOKINETICITY ACHIEVED

102.9

FLOW CONDITIONS DURING TEST -----

STACK AREA FT ²	78.54	OR	7.30	SQR M
ABS. STACK PRESS. (IN. HG.)	25.94	OR	658.80	MM HG
STACK GAS DRY MOL. WT.	28.98			
AVG. STACK GAS VELOCITY (FPS)	49.02	OR	14.94	M/S
GAS FLOW (ACFM-DRY)	213287	OR	6040	ACM/M
GAS FLOW (SCFM-DRY)	177311	OR	5021	SCM/M

AVERAGE COMPOSITION OF FLUE GAS

	DRY BASIS PERCENT	WET BASIS PERCENT
O ₂	18.50	17.08
CO ₂	1.50	1.39
CO	0.00	0.00
N ₂	80.00	73.87
H ₂ O		7.66

SPECIFIC GRAVITY OF FLUE GAS (AIR=1.0) 0.97

PARTICULATE EMISSION RATE -----

LBS/SCF	0.000E+00	OR	0.000E+00	GM/SCM
LBS/ACF	0.000E+00	OR	0.000E+00	GM/ACM
GRAINS/SCF	0.000E+00			
GRAINS/SCF (12% CO ₂)	0.000E+00			
EXCESS AIR (PERCENT)	665.47			
GRAINS/SCF AT 50% EA	0.000E+00			
GRAINS/ACF	0.000E+00			
LBS/HR	0.000E+00	OR	0.000E+00	KG/HR

CONCENTRATIONS ARE REPORTED ON A DRY BASIS
AT 25 DEG CENTIGRADE AND 760 MM OF MERCURY